THE LIFE OF MAN

Photo: L.M.S. Railway.

THE NORTHWARD-BOUND "CORONATION SCOT."

Rapid transport is essential in the modern world. Here we see the northward-bound "Coronation Scot" climbing the stiff gradient over Shap at 70 m.p.h. This famous British express, which first ran in 1937, did the 400 miles from London to Edinburgh in six and a half hours.

THE CITIZEN GEOGRAPHIES—BOOK II

THE LIFE OF MAN

by

B. G. HARDINGHAM, B.Sc.

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THE HOME OF MAN, by B. G. Hardingham. A vivid description of the planet on which man lives, the conditions under which he lives, and the way he has adapted them to his needs.

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THE LIFE OF MAN

CHAPTER I

OUR DAILY LIFE

IN the days of long ago life was much simpler than it is to-day in most civilized countries. Everything which a man and his family needed had to be obtained from the place in which they lived, or from not very far away. There were no shops, no roads, no fields or farms, no houses or factories.

When a man wanted a meal he had to go out and look for it. He might follow the trail of an animal which he could kill for meat, or his wife might collect some wild fruits, nuts, or berries. To secure his quarry the hunter had no rifle or shot-gun. At the best he might have a bow with arrows, or a spear with a sharp stone tip; at the worst he had a sling or a stone-headed club, or perhaps only a heavy stick.

When the chase was over, and the animal had been killed, it had to be skinned with a piece of sharp, jagged stone, and the meat had to be carried home without the aid of any barrow or other vehicle. Nor could it be left, for other animals would quickly eat whatever remained.

Even when the hunter reached home there were no arrangements for cooking—no kitchen range or gas-cooker, no oil-stove or oven. Instead of these there was an open, smoky fire. Unless the meat could be smoked or salted

Photo: Exclusive News Agency.

THE SIMPLEST LIFE OF ALL.

The natives of Central Australia need no house, no clothes, no work. They live upon grubs or caterpillars, birds, frogs, and other small creatures. They grow no corn, but collect grass-seeds, berries, and wild fruits. They have no settled home, but wander from place to place in search of food. These children, who belong to the Arunta group of blackfellows, are amusing themselves outside the rough bark shelter which is the nearest they have to a house. In the north the blackfellows have learned to make rough huts of leaves which are called "wurleys."

(and for a long time men did not know how to do either) it could not be kept, so it had to be eaten within a few hours.

Sometimes smaller animals could be trapped regularly by those who understood how to contrive traps or snares,

while the rivers or streams supplied fish. Thus men were *hunters* and *fishers*.

Clothing, where it was needed, as in the cooler regions of the world, had to be contrived from the skins of animals, without the assistance of scissors, needles, or thread. In the warmer regions, garments of leaves or grass were plaited.

Houses, such as they were, were usually only rough shelters, for without an axe no tree could be felled. Caves formed very useful, comfortable homes, and the earliest houses in Britain were rough stone-walled huts with tree branches covered with ferns as roofs. Osiers from the marshes, covered with mud or clay, were also used for building huts.

This primitive life of hunting and fishing is still followed by various peoples in different parts of the world. It is the only life possible where men do not possess the useful things that go to make up what we call civilization.

As the world grew up two great discoveries were made. First, men discovered that certain animals could be tamed or "domesticated"; that is, they could be trained to live near the homes of men, and could be accustomed to being with men. Some of these animals, such as cattle or sheep, could be kept in herds or flocks, others, like the horse or the dog, could be trained to be useful.

Thus in some parts of the world men became *herdsmen* or *shepherds*. They no longer needed to hunt, for they could obtain all the meat they needed from their own animals, besides having such useful things as milk, butter, and cheese. As the flocks or herds needed pasture, these herders gradually settled in the parts of the world where there are great grasslands.

The vast plains of Europe and Asia, known nowadays as the steppes, became the home of wandering peoples who

kept sheep and horses. The great tropical grasslands of Africa were occupied by tribes of cattle-herdsmen, whose descendants still dwell there.

The second great discovery made by man was that when the seeds of certain plants were put in the ground they would grow, and a harvest of seeds could be obtained. Thus men became *gardeners* and *farmers*.

As time went on these cultivators invented simple things to help them with their work. A stick was used to make holes in the ground. This digging-stick was followed by the hoe, and when the hoe was dragged along the ground it became a rough plough.

The men who became cultivators gradually settled in the more fertile lands of the world, where the soil and the climate helped them most. As they had given up hunting and they kept no animals as the herders did, they were not meat eaters, but lived upon the corn or fruit which they grew in their fields or gardens.

There was one great difference between the herders and the farmers; the latter were peaceful folk who had to live in the same place all the year round. The herders were often in the habit of stealing from the herds of their neighbours, and quarrels were frequent when two or more herds were driven to pasture on the same piece of grassland. Thus the herdsmen were usually fierce and quarrelsome, and when food was short they would raid the more peaceful and prosperous farmers.

The farmers, on the other hand, had no time for quarrelling. If they did so, their crops were ruined, and there was no food for a year. Then, too, the farmers learned how to store things. The yield of their harvests had to last for many months or until the next harvest. So the farmers became careful and thrifty. They even learned how to make

provision for years of famine, which was something the herdsmen could never do.

At one time or another all the rich farming lands of the earth have been conquered by raiders, who burned the towns and villages and carried off the savings of the people. Usually many of the conquerors remained in the country they had conquered and became the "landlords." They made the

Photo: Exclusive News Agency.

THE CULTIVATOR.

The plough has been one of the greatest civilizing powers in history, for the farmer must have peace if he is to reap and keep his crops. This photograph shows a native farmer in Pondoland in the south-east of Cape Province, South Africa, using a modern plough, imported from Britain.

cultivators give them a share of the harvest every year, and in this way "rent" was invented. Even to-day in India and Egypt the landlord is usually of quite a different race from the farmers, just as in England the Normans became landlords and the Saxons had to pay rent.

In the world to-day at least one half of mankind lives more or less in this simple way, cultivating the ground for which they pay rent, and using the same rough ploughs and hoes that were in use three thousand years ago.

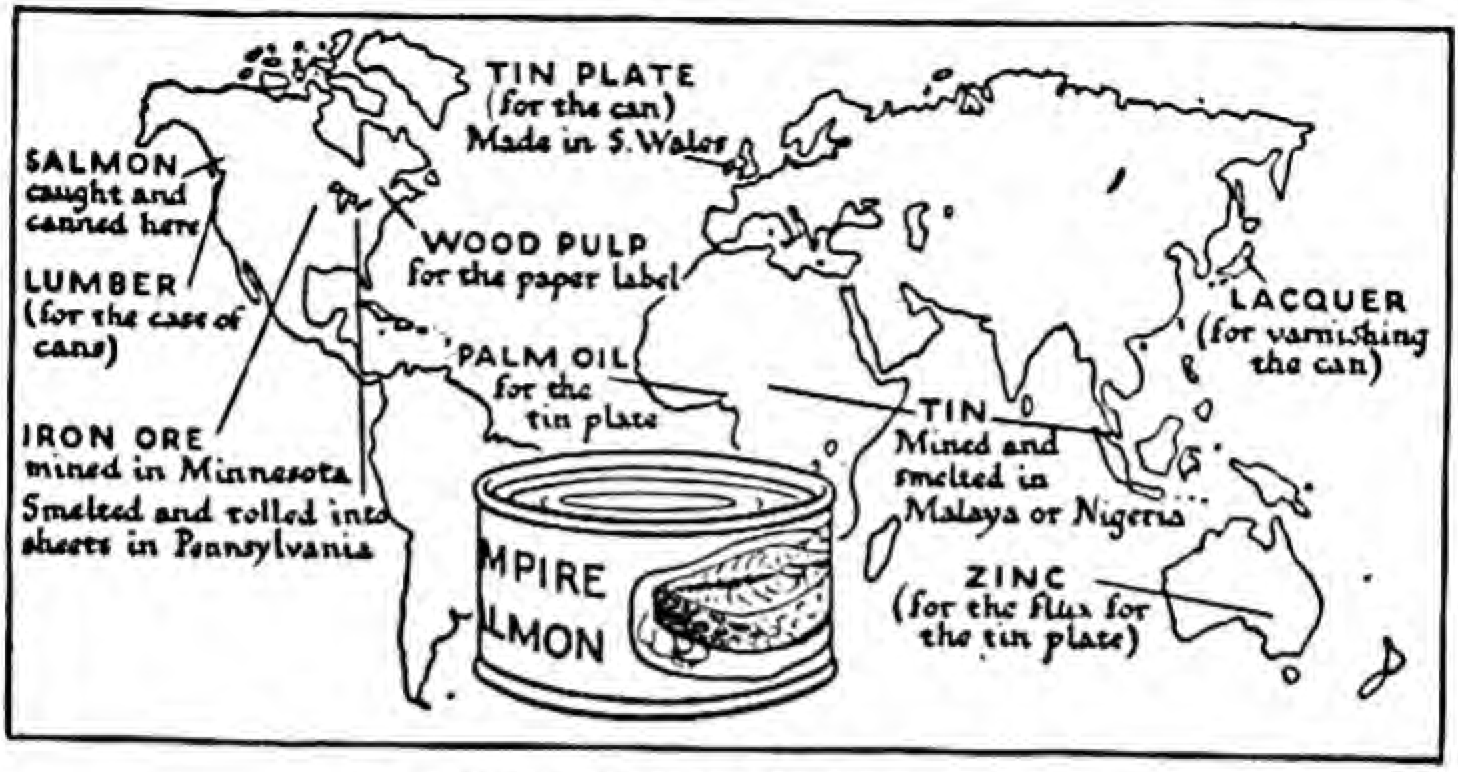
But in civilized lands, where you and I live, life is very different. Most of us have certain work to do, for which we are paid money. With this money we can buy the food and clothing which we need, besides many luxuries of which our ancestors never dreamed. Our homes are fitted up with all kinds of convenient and useful contrivances which add to our comfort. So long as a job is available and the world is not disorganized by war life seems fairly simple.

Yet it is, in fact, very much more complicated than most of us think. Let us take a peep behind the scenes and we shall see the world at work.

Suppose that I go to the grocer's and buy a tin of salmon. I pay the grocer the money and I can take home the tin of salmon. The contents are eaten, the empty tin is put in the dustbin, and there is an end of the matter. I have not had the bother of catching or cooking the salmon and neither has the grocer. That has all been done beforehand, and I need not even have carried the tin from the shop, for the grocer would have sent it.

Yet to provide me and others like me with our tins of salmon at least two hundred people have been at work (and possibly many more than that). They have been employed in a dozen different countries and are people of all colours and races—white, brown, yellow, and black. Let us see how it has been done.

First of all the salmon was caught in a river of Western Canada, more than 6,000 miles away. It was cut up and cleaned by a machine made in the United States, and was put into tins by Canadian girls. To provide the steam for the big steam ovens in which the fish was cooked, men were working in a large boiler-house, while miners had to dig the coal, which was sent by train or ship or lorry to the cannery.



THE WORLD SUPPLIES A TIN OF SALMON

This map shows how widely separated parts of the world supply what is needed for the making of a common article of trade—a tin of salmon. Nowadays no country can be entirely self-supporting, and prosperity in one country can be greatly affected by distress or war in another. Unwise taxation or unnecessary restriction on trade between countries has the same bad effect. This is why most countries have commercial treaties with each other.

Away in the woods, lumbermen felled the tree which provided the wood for the packing-case in which the tins were packed. The timber had to reach and pass through the sawmill, and the pieces of wood were cut and fitted in a box factory.

The tin in which the salmon was put had an even more remarkable history. The iron of which it was made was dug up as iron ore in the state of Minnesota in the United States. From there it was sent by train to a big harbour where it was loaded by very wonderful machinery on to a large steamer. The crew of the steamer then brought the ship across a thousand miles of water and through a great canal with several locks to another harbour, where the ore was unloaded and sent by train to the steel works in Pennsylvania.

At the steel works it was mixed with coke which had

been made in a great gas works, and with stone which had been quarried miles away. Dozens of men were busy looking after the blast furnaces, collecting the molten iron and rolling it out into the thin sheets from one of which the tin was to be made.

When the sheets of iron were ready they were packed into cases and sent on a long canal journey to New York, where they were loaded on to a big ocean steamer and sent across the Atlantic Ocean to South Wales. There they were taken to the big tin-plating works to be covered with a thin layer of tin.

This tin is mined in Malaya, far away on the other side of the world, and the workmen are Chinese. The tin ore is smelted into tin at great tin works near Singapore, and is then sent to Britain through the Suez Canal. During the tin-plating, other materials are used, such as palm oil which comes from West Africa, and is produced by negroes. A preparation of zinc is also needed, which comes from the great mines at Broken Hill in the interior of Australia. Certain acids made in Cheshire are also needed, as well as some very wonderful machinery, which is made near Birmingham.

When the tin-plating is finished, the sheets of polished tin are sent all the way back to America, and across Canada by train to the cannery. There the machines press them into cans, ready for the salmon. After the tins of salmon have been sealed up, they are coated with a varnish which comes from Japan.

Even the label round the tin means work for many people. The paper was made in a paper works, the inks and colours had to be made from substances which come from all over the earth, while the printers had to use machines to print the labels.

Nor is that all, for when the cases of salmon were ready they

had to be sent by ship to England. Dock workers with big cranes and other machinery helped to unload the ship. Railway workers drove the train, worked the signals, and saw that the box of tinned salmon was safely delivered to the grocer.

Thus the money which I paid for the tin of salmon, although it was only a few pence, helped to pay all these workers—Canadians, Americans, Malayans, Chinese, Japanese, Australians, Negroes, Britons. Miners, engineers, fishers, sailors, and farmers all did something to help, not to mention the grocer, the clerks, and the bankers.

All that is very wonderful, and it helps us to understand how the world is at work at the present time. Our own work, no matter what job we may have, is just a small part of the work needed to supply the world with something it needs. It does not matter whether we work on the land or in a factory, or in a shop, an office, or a bank. Our work is helping to produce something which is needed in everyday life.

In fact when we consider the world at work we can divide mankind up into at least nine great classes :

The people who grow things.
The people who make things.
Miners.
Fishers.
The folk who carry things.
The folk who buy and sell things.
The women who mind the homes.
The folk who amuse us.
The folk who look after us (such as doctors, lawyers, teachers, police, and other government servants).

In the following chapters we shall take a peep at these workers and see just how they help to make our daily life possible.

CHAPTER II

THE FARMER

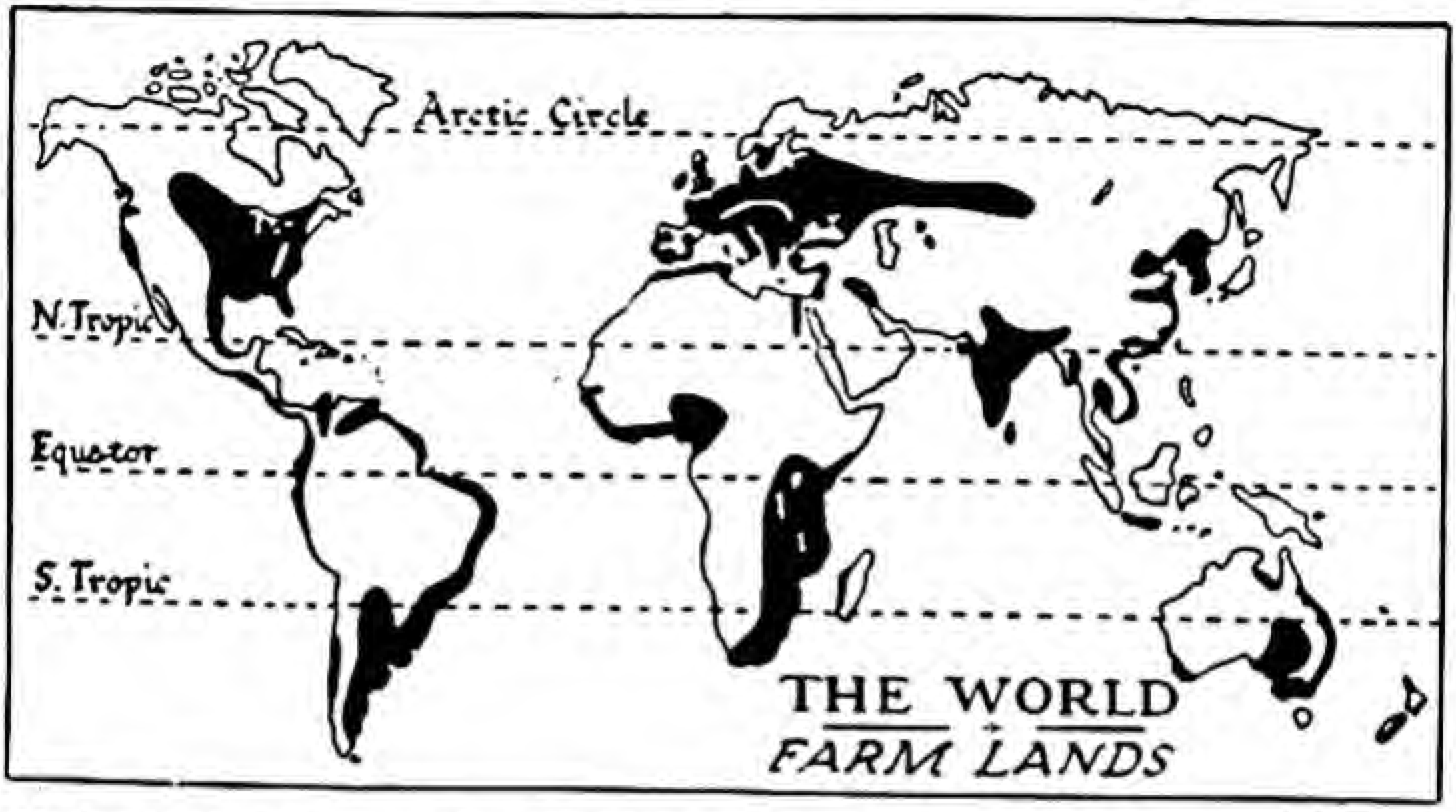
THE work of the farmer is much the same all over the world. First the ground has to be cleared of what was growing upon it. Then the land must be ploughed, and the seed has to be sown. While the crop is growing, it usually needs to be looked after, especially in hot countries where weeds grow quickly.

When harvest time comes, the farmer is busier than ever, for the crops have to be cut and the harvest must be gathered in. Even after this has been done the work of the farmer is not finished, for corn needs to be threshed, ricks have to be thatched, and the produce must be properly stored or got ready for market.

In different parts of the world these agricultural operations are carried on in different ways. The coloured farmers of Africa and Asia do most of their work by hand, without any machinery. Women, and even children, have to help at the busy times of the year, and the harvest is stored at home for the use of the family.

In other lands farming is much more like a business. The farmer pays men to do the work for him (though, of course, he usually works himself as well), he uses expensive machinery, and he sells his crops instead of keeping them. It is this last kind of farmer who supplies the food and other things which we use in our everyday life.

In most countries the same land is used over and over



Notice that only a small part of the surface of the earth is used by farmers. The rest is either too high, too wet, too dry, too hot, too cold, or too barren for successful farming. There are three great types of farmland: (1) the *temperate* farmlands which are mainly in Europe, the eastern parts of North and South America, and South-eastern Australia; (2) the *tropical* farmlands which are mainly in Africa; (3) the *monsoon* lands in India and Eastern China. Parts of Japan are also very carefully cultivated.

again for farming. Indeed, there would not be enough land to go round if the farmer were to use fresh land. In one or two parts of the world, as in tropical Africa, and in the forests of South America, the native farmers clear a small patch of forest and use the ground for two or three years. Then they move to another part of the forest and do the same thing again. This, of course, is very wasteful, but as there is plenty of land and there are not very many people the waste does not matter.

Most of the food of the world, however, is grown upon land which is used for no other purpose. Thus the farmlands of the world are covered with a network of fields, which are cultivated year after year. The houses of the farmers are not far away. In some countries, as in England or France, the farmer lives on a farm which contains all the

Photo: Exclusive News Agency.

COTTON FARMING IN THE SUDAN.

Many crops, especially in tropical countries, need constant attention. These native workers are using long-handled hoes to thin out the cotton plants, so that they may have plenty of light and air, and to clear the ground of weeds. The Gezira Plain, where this photograph was taken, is in the Anglo-Egyptian Sudan, and is irrigated from the Sennar Dam across the Blue Nile. Most of the cotton is exported to Lancashire, via Port Sudan on the Red Sea.

buildings needed for the animals and for the storage of his machinery and crops. His workmen usually live in cottages close by the farm buildings. In other countries, as in Italy, or in eastern lands, the people live in villages within a mile or so of their fields.

Even in the crowded factory districts of Europe and North America, food growing is still very important, and the fields may reach up to the very walls of the factories. In such places the farmers grow corn to sell to the millers, vegetables for sale to the shops in the towns or cities, and certain crops for feeding animals. They also provide milk, eggs, and bacon for the busy factory workers.

Only some of the fields on such farms are used for crops.

The land in such fields is called *arable*, which means "ploughed land." Other fields are used for *pasture*, and here such animals as sheep, cattle, or horses may be kept. Parts of the land where nothing may be growing for the time being are called *fallow*.

In some parts of the world, however, only one kind of farming, for which the land or the climate is specially suited, is carried on. There are three important kinds of farming. First comes *arable farming*, where the farmer grows certain crops, but does not bother much about animals. Then there is *stock farming*, or ranching as it is sometimes called, when the farmer keeps animals in large numbers, and does not grow any crops. Lastly there is *fruit farming*, which is often combined with the growing of vegetables.

The kind of farming that is carried on depends upon the kind of soil, upon the climate, and upon the situation of the land.

Different kinds of crops need different kinds of soil. Land that is good for wheat may not be of much use for certain other crops. Of course a piece of land can be used for growing several kinds of crops, but generally one or two kinds of crops will grow better than others. The farmer has to make a living by selling the crops which he has grown, and so he always tries to grow the crops to which the land is best suited.

Much depends upon whether he can sell his crops when he has grown them—that is upon whether the things which he grows are really wanted. Certain foods or other plant products are always needed, and it is these crops which are grown in the largest quantities.

In some parts of the world, for example, the farmers find that it pays them best to grow wheat. In other parts they may grow sugar-cane, or cotton, or tea, or rubber.

HOW THE LAND IS USED IN NORTH AMERICA.

This map shows the many kinds of farming which are carried on in one continent. Fast transport services by road, rail, and air enable produce to be carried to other districts, so that fresh fruit and vegetables, or even tropical produce, may be bought in the depth of winter in cities that may be hundreds of miles away from where they are grown.

Every crop needs different ways of caring for it. Some crops are grown from seed, others from cuttings, others are gathered from trees or bushes.

Nowadays every important crop has been studied carefully, so that the farmer is able to know just what is the best way of growing that particular plant. Then, too, because others are also growing the same crop, he has to take care that what he grows is as good as or better than that grown by other people. Otherwise he will not get such a good price for his produce.

Photo: Rothamsted Experimental Station.

AN EXPERIMENTAL WHEAT FIELD.

This shows an air view of the famous Broadbalk Wheat Field on the Rothamsted Experimental Station in Hertfordshire. Each of the strips has been treated in a different way. The results obtained here over many years have helped to improve wheat cultivation all over the world.

In many cases it is possible to improve the crops by doing something to the soil. In some parts of the world there may not be enough water for the needs of the crops. The rainfall is one of the things which man cannot turn on when he wants it. The farmer has to take the rain as it comes.

In some lands the ground is quite fertile when there is sufficient water, and in many of such places the water can be obtained from rivers or lakes. Ditches are dug from the river to the fields, and thus the plants are supplied with water.

Egypt is a country where this *irrigation*, as the process is called, has been carried on for thousands of years. The farmers there had to look after their own supply of water, and this was easily managed so long as they had a farm next to the river. If, however, a farm was a long way from a river it was very difficult to get water.

Nowadays the supply of water to farmers is almost always provided by the government of the country. Huge dams costing millions of pounds have been built across rivers in convenient places so that the water can be stored up. Canals and water channels have been dug so that the farmers for scores of miles around can be supplied with the water.

Such irrigation schemes are in use in many lands, especially in the dry north-west corner of India known as the Punjab, in south-east Australia (see page 103) and in south-west U.S.A.

Another way in which the farmer can improve the yield of his ground is by what is known as *rotation of crops*. If wheat, for example, were grown on the same land year after year, the ground would become used up or exhausted. Every crop takes something out of the ground, and the good farmer tries to put back as much as he can.

He can do this by ploughing in the stems or straw of the plants, and then growing a different crop the following year. Often some kind of green stuff, such as will provide food for animals, is grown.

Even on the wheatlands of Canada, where wheat is the only important crop, the farmers are finding that they have to give the land a rest. So wheat is grown one year, and some other crop (usually green stuff) the next year.

Yet another way in which the farmer can improve his land is by using what are called *fertilizers*. In countries where

Photo: High Commissioner for Canada.

POWER PLOUGHING ON THE PRAIRIES.

The most modern development in agriculture is the power-plough, such as this, which cuts four or more furrows at a time. The use of such machinery is turning the modern farm worker more and more into an engineer. Notice the headlamp, which enables ploughing to be continued at night when necessary.

farm animals are kept it is usual for the farmers to use manure. In other countries or districts, chemicals have to be used. These supply the land with the materials which have been used up while the crop was growing.

Nowadays the making of fertilizers is a very important occupation, because farmers are finding that they cannot do without fertilizer. Even in countries like Egypt and India the native farmers are beginning to buy chemical fertilizers.

The farmer of to-day also uses machinery much more than was the case years ago. This machinery is mainly to help him to harvest his crops, but there are also wonderful machines which help him to cultivate the ground.

The plough is a very ancient farming implement, but

to-day it has been improved. In countries like Canada, ploughs which will cut several furrows at a time are used.

Then, too, there are machines for loosening the soil, others for sowing the seed, and others for removing weeds, while powerful motor tractors are used instead of horses. Hay is turned over by machinery, and loaded on to the ricks by other machines.

Harvesting and threshing machines are even more wonderful. The binder not only cuts the crop but ties it up into sheaves. The thresher separates the grain from the ear, and the grain is gathered into bags.

Perhaps the most remarkable machine of all is one which is used nowadays to a great extent in North America. It is called the "combine-harvester." This machine cuts the crop and threshes it, and the bags of grain are dropped out as the machine goes along.

Besides all this machinery, the farmer also uses machines at the farm itself. Food for animals is cut up by these machines, and cows may be milked by machinery.

The last way in which the farmer is helped nowadays is in selling his crops. In those parts of the world where the farms are a long way from the sea, railways have been built, and all that the farmer usually has to do is to take his produce to the railway. The corn is sold for him, it is carried to the coast and sent across the ocean without any further trouble.

This marketing is carried out so very cheaply, that in many cases the produce of the farmer in Canada or Australia or New Zealand can actually be sold in Britain more cheaply than it can be grown by the English farmer.

This is not due to the wages paid to the farm worker, for in all these lands the farm worker is paid at least twice as much, and in some cases even four times as much as the labourer in this country.

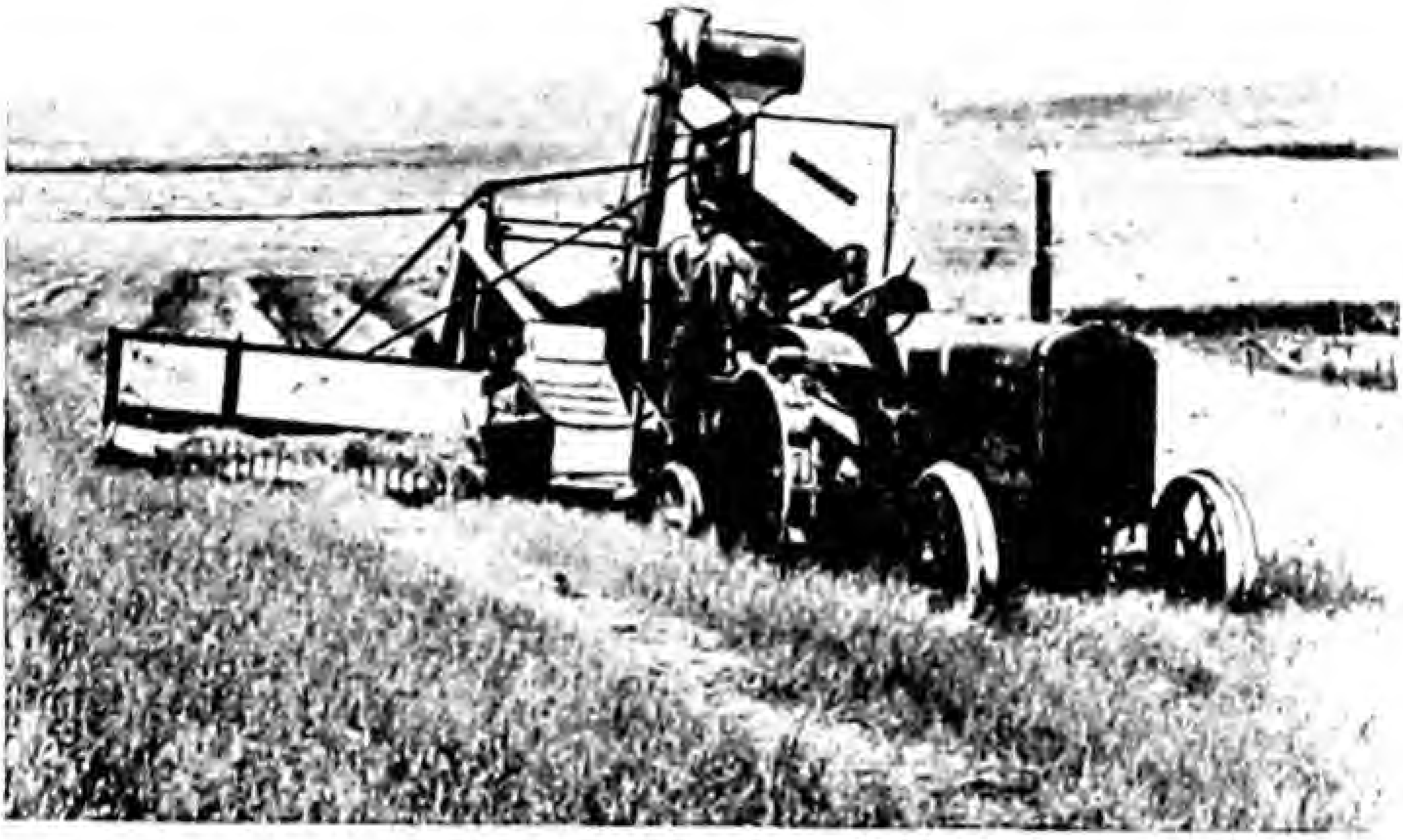


Photo: Exclusive News Agency.

MODERN HARVESTING IN CANADA.

On the big wheat farms of North America the "combine" is being increasingly used. This is a machine which cuts, threshes, and grades the wheat. It is towed by a powerful tractor, and cuts a swathe much wider than the ordinary harvester. The biggest combines cut a width of twenty-four feet, and require two men to operate them, but small, one-man machines are more common. The wheat may be collected into storage bins which are emptied at intervals, or it may be bagged, ready for transport. Such machines are seldom used in Britain, where conditions are not suitable. This machine is at work in Alberta, the most westerly of the prairie provinces.

Of course the farmer in Britain may have to pay a higher rent for his farm, but most of the good farmland overseas costs almost as much as it does here. The great reason for the success of the overseas farmer is that his produce is marketed very cheaply and well.

In Britain people are beginning to understand that good marketing is needed, and so the Government have established several "Marketing Boards" whose work is to do for the farmer what is already being done for farmers in other lands.

Chapter III

OUR DAILY BREAD

THERE is a well-known saying that "Bread is the staff of life," by which we mean that it is the most important food by which life is sustained. Nearly every race upon earth eats bread in some form or another. The wife of the Australian blackfellow makes a kind of bread from roots, which have been ground into flour. The Arab woman bakes flat scones of barley, while the Russian peasant eats rye bread.

Where bread is not used the people usually eat a kind of porridge. The Kaffir of South Africa lives mainly upon maize porridge. In India and in other eastern lands, rice is boiled and eaten in this way. In fact grain of one kind or another forms the staple food of the vast majority of people upon earth. Only a very few tribes of hunters or herdsmen manage to live without it.

Most of the bread or porridge of the world is prepared from the seeds or "grain" of certain plants which are known as "cereals." A cereal is really a particular kind of grass, which has been cultivated so that its seeds have become much larger than in the wild plant. Such grasses are wheat, oats, barley, and rye, which are all grown in temperate countries. In hot lands other kinds such as maize, rice, and millet are grown.

The most important cereal for the white people of the world is wheat, from the flour of which our daily bread is

made. Rye is also very important in lands where the people are poor, but rye bread is not as tasty as wheat bread. It is so dark in colour that it is often called "black bread," whereas bread made from wheaten flour is light brown or almost white. Barley and oats are not used for bread-making to the same extent.

Each of these cereals needs a different soil, and different

The wheat-growing lands of the world are widely separated. This is fortunate, because not only are the harvests spread out over the year, but there is little likelihood of a world famine.

weather. Often only one cereal can be grown in one place, and another elsewhere. Oats, for example, will ripen in the north of Scotland, where wheat could not be grown. Usually the farmer knows from experience just which is the best food crop for his land, and he grows that which will pay him the best.

Some of these bread plants are grown in very large quan-

tities. Because wheat is used by most of the white people of the earth, certain parts of the world are used for growing nothing but wheat, and thus have become the granaries of the world. The growing of wheat in such places has become so important that farmers in other lands find it does not pay them to grow wheat, and so they use their land for other purposes.

In England, for example, the English farmer cannot grow wheat to sell at such a low price as grain from the wheatlands of America or Australia. In fact the British Government has had to help the wheat growers in England by making up the money which is paid for English-grown wheat to a price at which the farmer can make a profit. If the Government did not do this there would be very little wheat grown in England.

The great wheatlands of the world are all large plains, where the work of the farmer can be carried on without much trouble. Except in India, these wheatlands are all in the temperate lands. Because wheat is a grass, it grows best on the temperate grasslands of the world. In such lands there is not much rain, while the winters are cold and the summers are fairly hot, *i.e.* they have an "extreme" or continental climate.

A clay soil is also best for wheat, and it so happens that these great plains are covered in places with a layer of clay. Thus the great grasslands of the Northern Hemisphere, which once were used almost entirely by herdsmen, have now become the important wheatlands of the world.

In the Southern Hemisphere wheat is grown in large quantities on the grasslands of Argentina and South Africa. It is also grown in the southern parts of Australia.

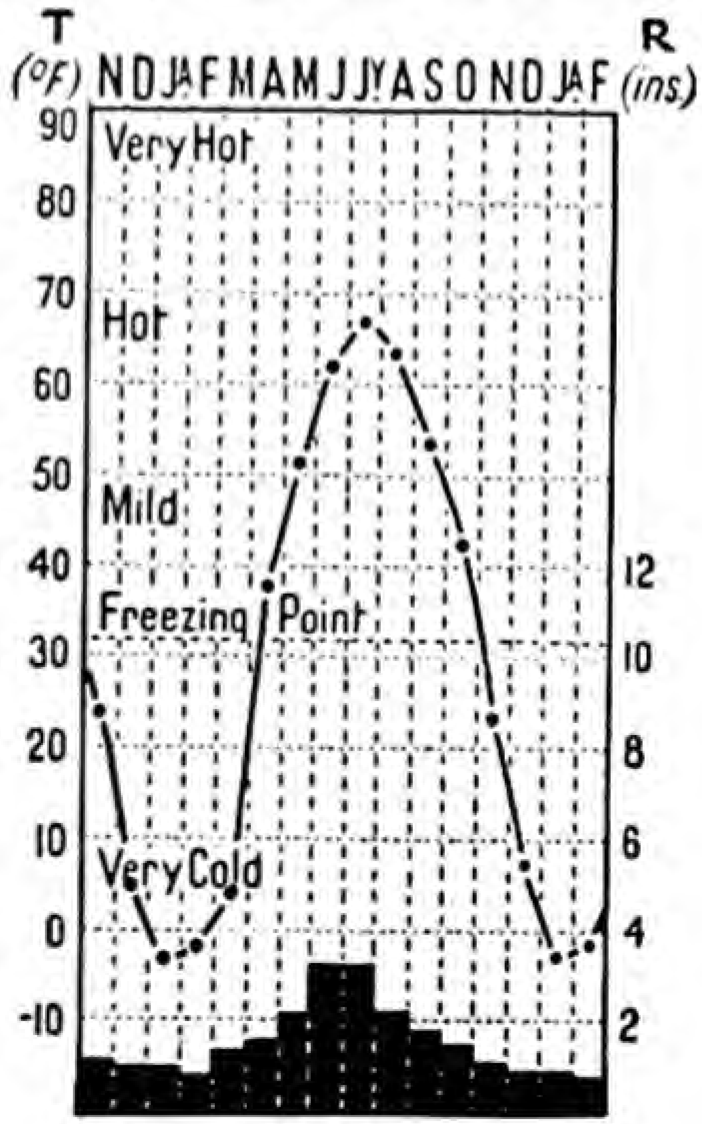
In all these lands the work of the wheat farmer is much the same. First the land has to be ploughed. This is usually

done in the autumn, and the farmer likes to leave the ploughed land exposed to the air and weather for as long as possible. This improves the soil, especially where the winters are cold, for the frost helps to break up the soil.

In some countries the wheat is sown in the autumn, as it is in England. This can only be done where the winter is mild. The young wheat plants begin to grow before the cold weather, and their roots become strong. During the winter the plants do not grow much above the ground, but when spring comes round the wheat grows rapidly, and is ripe by the middle of the summer.

In Mediterranean lands where the winters are very mild the crop ripens very early, and is ready for cutting soon after Easter. In India wheat is grown during the "cool" season and is harvested in January or February.

In lands like Canada and Russia, where the winters are very severe, the most of the wheat is grown in the spring.



CLIMATE OF WINNIPEG.

Temperature is shown by the line, and rainfall by the shaded part at the foot. The graph shows a typical continental climate such as is suited to wheat. The cold winter helps to clean the ground if ploughing can be done in time. Notice the sudden rise in temperature in April, and the sharp fall after September. Wheat can only grow when the temperature is above 40° F., so it cannot be sown before the middle of April. Notice, too, that the rain comes just when it is wanted, during the growing season, and that the harvest months are fairly dry. Contrast this climate with that of Allahabad shown on page 36.

As it must be ready for harvest before the end of the summer, only special kinds of wheat, called " spring wheat " can be grown in these lands. Spring wheat grows faster and ripens more quickly than " autumn wheat."

The first wheat to be grown on the great prairie lands of Western Canada was a special kind called " Red Fife." The story of how the Canadian farmers came to discover this wheat is one of the romances of the world.

A Scots farmer called David Fife was living in Ontario in Eastern Canada. He tried for several years to grow spring wheat which would ripen, but without any success. Then one day he received a letter from a friend in Glasgow, who sent him a handful of wheat which had been picked up in the hold of a ship from which wheat was being unloaded.

David Fife planted the few grains of wheat which his friend had sent, but it all died except two plants, which ripened. The farmer carefully collected the grain from these ears and sowed it the following year. This time most of the plants grew and ripened. Again the seed was saved and sown, and David Fife had the satisfaction of getting a harvest every time.

Some of the seed was then distributed to neighbouring farmers, and in every case the grain ripened. The wheat became famous and was named after its discoverer. To-day, during each summer, thousands of square miles of prairie land are covered with golden grain which has provided cheap bread for millions of people for many years.

As Canadian wheat has to be sown, grown, and harvested within four and a half months, great efforts have been made to find a kind of wheat which would grow and ripen quickly. There are now several kinds which are ready in from 95 to 110 days from the time of sowing. These wheats are used by the farmers in the newer farmlands to the north, where the

summers, though hot, are very short. The most celebrated of these northern wheatlands is that of the Peace River.

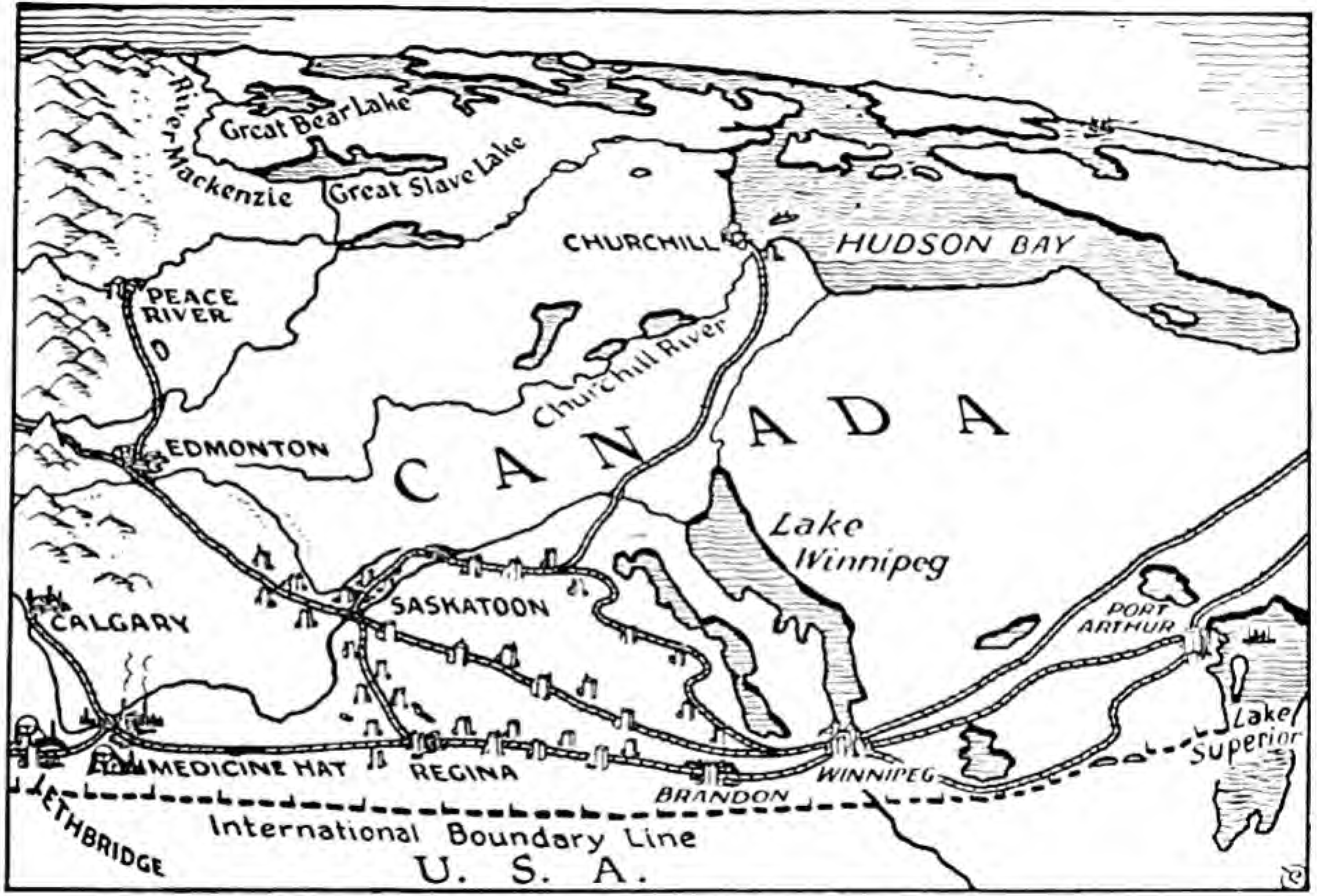
The wheatlands of North America are in the centre of the continent, far away from the sea. Practically all of the grain, when it has been harvested, has to be sent for hundreds, or even thousands, of miles before it reaches the millers, who will grind it into flour, or the bakers who will make the flour into bread.

It is therefore very important that the American farmer should be able to "market" his wheat easily and cheaply. This work is done for him by big grain companies, which work with the railways. Running through the wheat farming lands are many lines of railway, which help to carry the wheat to the factory cities near the Atlantic coast, or to big ports such as New York or Montreal, whence it can be sent to Europe.

All the American farmer has to do is to take his wheat to the nearest railway. He usually does this in a motor "truck" or lorry. Beside the railway line there are tall tower-like buildings called "elevators," in which the wheat can be stored. Here the farmer leaves his wheat. It is examined, weighed as it is stored inside the elevator, and the truck-driver is given a ticket to show that so many bushels of wheat have been received.

The farmer will be paid the market price of the wheat for that particular day, and will receive the money a week or so later. He can tell what the market price is likely to be by looking at his newspaper, or by listening on the wireless.

Practically all the Canadian wheat is sent to Winnipeg. This is a very big railway junction, where all the railways from the Canadian wheatlands meet. Winnipeg is just to the south of a long narrow lake round which the Canadian railways must pass. Thus Winnipeg is a good place at which wheat may be bought or sold.



THE PRAIRIE WHEATLANDS OF CANADA.

The railroads are the farmers' life-line. Those to the east run to the St. Lawrence ports of Montreal and Quebec; those to the west to Vancouver. The Hudson Bay route is only open August–September.

The wheat traders, or "brokers" as they are called, meet in a big building called the Wheat Exchange, where the brokers never see the wheat which they are selling. All the business is done inside the Exchange or in the broker's own offices. The railway companies send the wheat to big "pool" or "terminal" elevators in the places where it is wanted. There are many of these huge terminal elevators at the ports, and from these the wheat can be loaded into ships just as it is wanted.

All American wheat is handled loose, and it is pumped through pipes or carried upon travelling bands inside the elevator buildings. Each of the towers in an elevator is really a big bin, inside which the wheat can be kept clean and fresh for a year or more.

Most of the wheat which is grown on the wheatlands of the United States is sent to Chicago. This is in much the same kind of position as Winnipeg. The U.S.A. railways have to go round the end of Lake Michigan, and so Chicago is the biggest railway junction in the United States. The Wheat Exchange at Chicago is even more important than that at Winnipeg.

The wheat prices, both at Winnipeg and at Chicago, are given in most English daily papers. They are given in cents per bushel. Thus, on a certain day in September 1940, the price of wheat at Winnipeg was said to be "Oct. 84½." This means that wheat to be delivered in October was sold for 84½ cents per bushel. (Counting the cent as worth about a halfpenny, this price meant 3s. 6d. per bushel, or 29s. per quarter of 480 lb.).

The same kind of wheat was being sold in London on the same day on the Baltic Exchange (which is the big grain market for London) at 32s. 6d., or only 3s. 6d. more than at Winnipeg. This 3s. 6d. represents the cost of carrying

480 lb. of wheat all the way by railway and steamer from Winnipeg to London—a distance of nearly 5,000 miles.

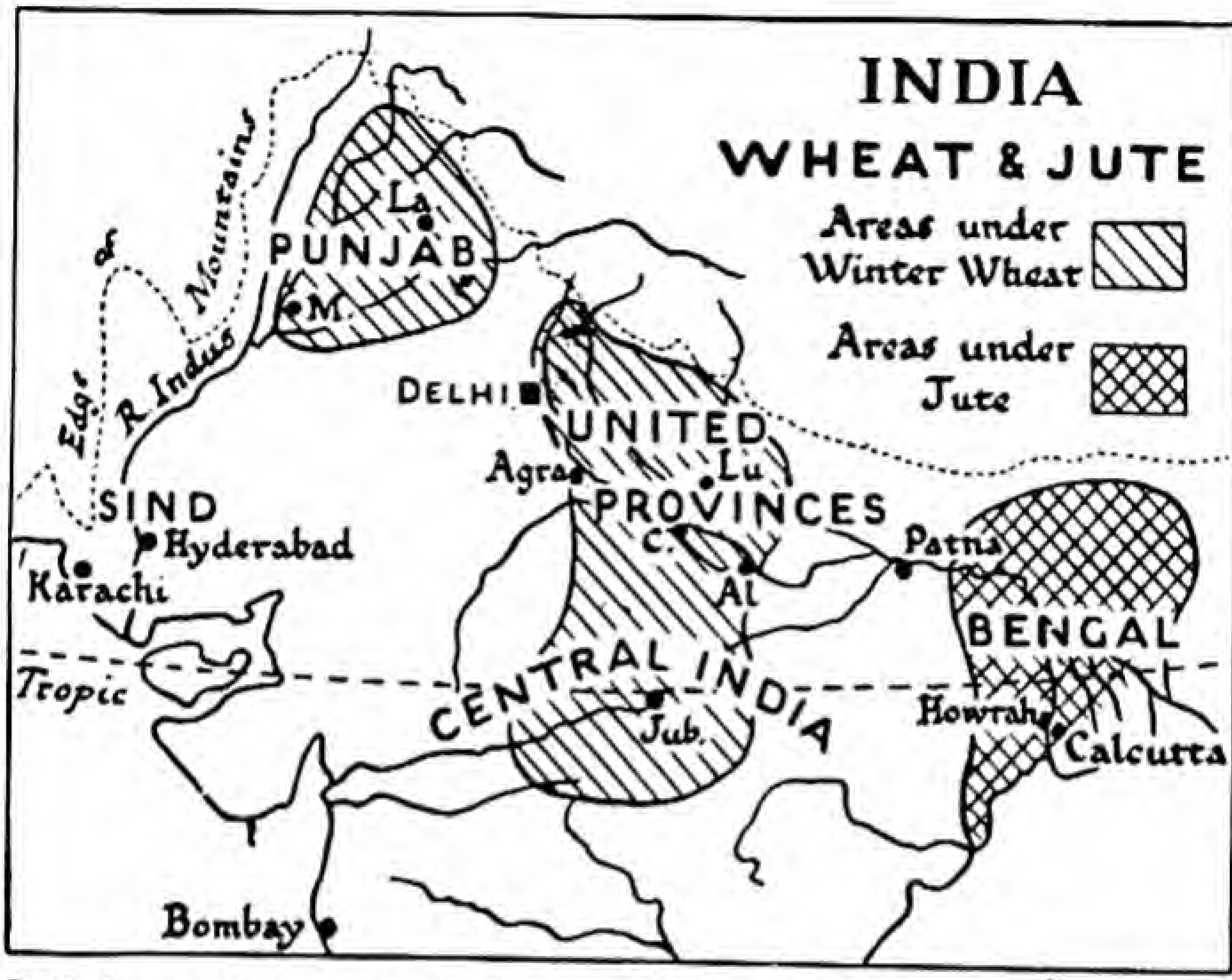
Although North America is the largest of the granaries of the world, wheat is also grown on the pampas in South America. The pampas are great level grasslands in Argentina, near the mouth of the river Plate. As in Canada, many railways have been built across the plains to carry the harvest to the ports. But the Argentine wheat does not have to travel very far, for the plains reach right to the sea, and there are no mountains to hinder the railways.

In South America most of the labourers on the farms are half Indian. They work very long hours for low wages. Because of this the Argentine wheat farmers can grow wheat more cheaply than in Canada, where land is dear and wages are high.

The wheat cargoes are shipped from ports on the river Plate, like Buenos Aires—which is the capital of Argentina, or from La Plata, which is not far away. As the hot weather in this part of the world comes at Christmas, the harvest in Argentina takes place in January.

Another important wheat-growing land is Australia. The wheat is grown mainly in West Australia, South Australia, and in parts of New South Wales. The harvest in this part of the world comes in January as in Argentina, but in South Africa, where wheat is also grown, it is cut in November.

In Northern India, wheat is grown during the "winter," or cool season, although the weather there, even at that season, is hotter than an English summer. Most of the Indian wheat is grown in the Punjab or "Land of the Five Rivers," in the north-west corner of India. The wheat is sent by railway to the busy port of Karachi near the mouth of the river Indus. Karachi is also an important airport for the airway between Britain and India. Indian wheat is



India is one of the great wheat-growing lands of the world, the crop being grown during the dry, cool season (November-February). The Punjab is the main wheat-exporting area, the grain being shipped from Karachi. Jute is grown only in the hot, wet lands of Bengal, and especially in the delta of the Ganges. It supplies fibre for sacking, and provides material for the factories in Howrah and Calcutta.

rather hard, and does not make such useful flour as Canadian wheat. It is harvested in February.

A good deal of wheat is also grown in Northern China, and on the great plains of Manchukuo, which may be called the Canada of Asia.

Many European peoples grow wheat, but they do not send much of their grain to Britain. Indeed they usually have to buy corn from other parts of the world because there are so many people to be fed. Spain, Italy, and France are important wheat-growing lands, but they also import wheat to help to feed their own people.

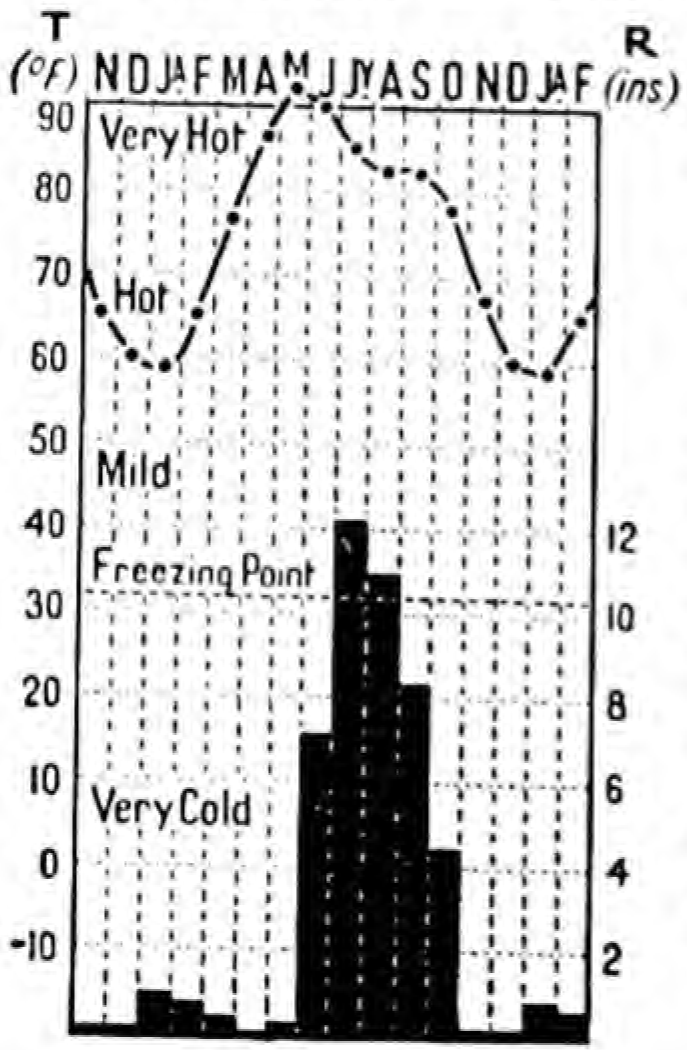
In Eastern Europe, in countries like Poland and Russia, the farmers also grow rye, which will ripen on poorer soil, and is not so easily damaged by bad weather.

Barley is another important cereal crop which grows in temperate lands. It is used mainly for making malt, which is needed for breweries. Good barley costs three times as much as wheat. The finest barley in the world is grown in North Kent.

Oats will grow in a much cooler and damper climate than wheat. It is grown for food in lands like Scotland, Ireland, Denmark, and Sweden. In other countries, oats are grown as a food for horses.

Maize is rather different from the other cereals. It is much larger, and the grains grow in a "cob." It grows in warmer lands, and is especially useful as a food for animals. In South Africa the natives call it "mealies," and the crop is grown for food. A great deal of maize is also grown in India.

The most important maize-growing land in the world is



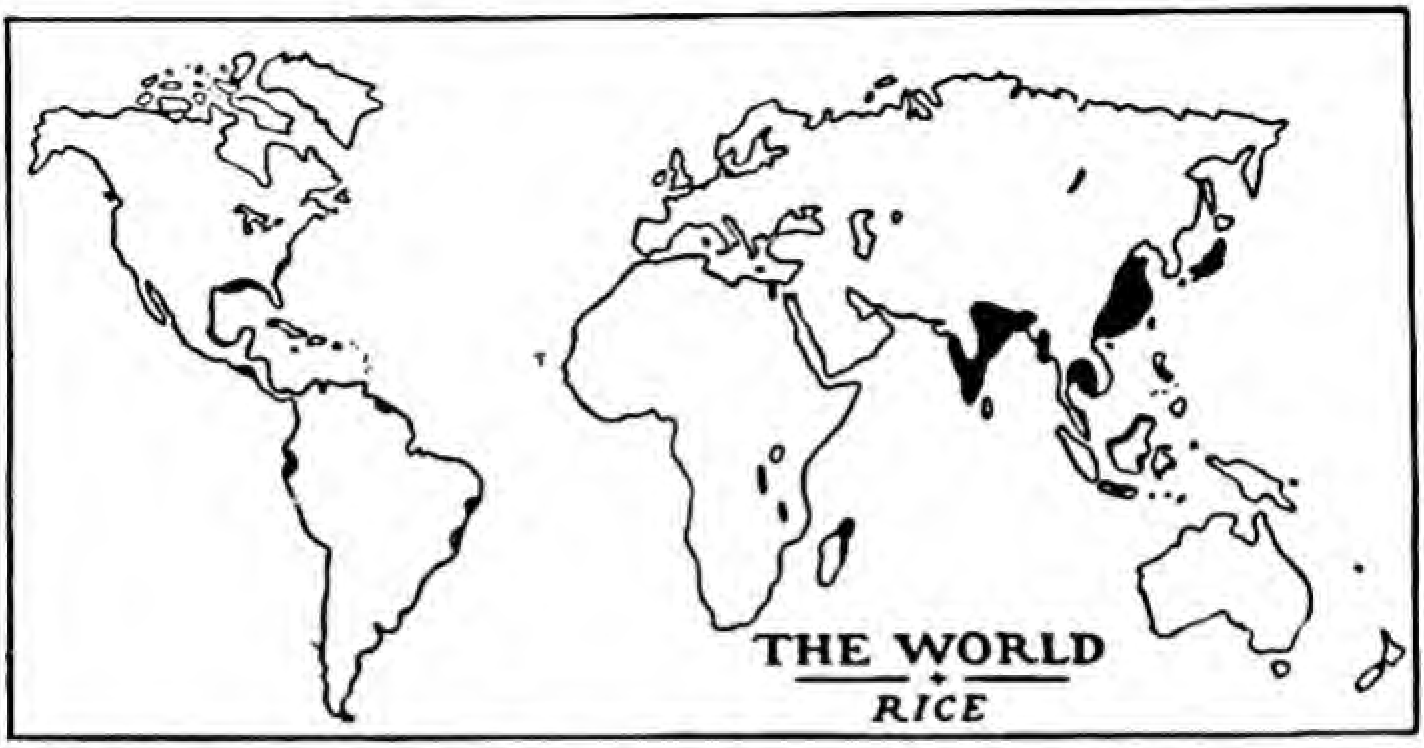
CLIMATE OF ALLAHABAD.

The graph shows a typical monsoon climate. The temperature seldom falls below 60° F., and is over 80° for six months. Notice that the hottest month is May, before the monsoon brings the rain. The wet cloudy weather helps to keep the temperature down. The three seasons in India are the *monsoon* (June–October); the *cool season*, which is also dry (November–February); and the *hot season* (March–May). In such a climate two crops a year are the rule.

RICE FIELDS IN MALAYA.

Rice requires a great deal of water, which is supplied by flooding the fields from the nearest river. As the rivers are swollen by the monsoon rains during the growing season, this enables the flooding to be carried out easily. Earthen banks between the fields serve as footpaths.

the United States of America. The farmers there grow four times as much maize (or " corn " as the Americans call it), than all the rest of the world put together. The American farmer does not, however, grow " corn " in order to reap and thresh it. Instead he grows " corn " for fattening cattle and pigs. To him his maize crop does not mean so many bushels of grain, but so many pounds of beef or pork. Much



Rice is an Old World crop, and is grown mainly in the monsoon lands. Rice is also a farm crop in the southern U.S.A.

of the maize is cut while it is still green, for the stalks of the plant are very sweet and juicy. The cattle, when they have been fattened, are sold to big factories to be turned into "tinned" meat.

Maize is also grown in the warmer parts of Argentina and in Rumania, a European country near the mouth of the river Danube. Most of the maize which is sold in Britain comes either from Argentina, Rumania, or South Africa.

While wheat is the white man's bread, the coloured races of the world live mainly upon either rice or millet. Rice is grown in all tropical lands. It needs a great deal of heat and moisture, so that most of the rice fields are kept flooded with water until just before the harvest. Most of the rice of the world is grown in the "monsoon lands" of India, China, and Japan. There are so many millions of people living in these lands, however, that they cannot grow enough rice to feed themselves, and have to buy rice from other lands. Most of the rice seen in Britain comes from Burma.

The rice fields of Burma are flooded by the heavy summer rains, or from the rivers. The grain is cultivated by hand, for the native farmers have no machinery. When the rice or paddy has been threshed, it is loaded into big sailing boats which carry it down to Rangoon. At Rangoon there are big rice mills where the brown husk of the paddy grains is ground off to make the white rice which English people like.

Millet is not used in England, but it is the principal food of millions of people in Africa, India, and China. There are many different kinds of millet. It does not need so much rain as rice, and can therefore be grown at a different time of the year. The principal rice harvest is from November to December in monsoon lands.

A Grain Market Report

The following kinds of grain were mentioned in the *Daily Telegraph* in the daily report on the "Baltic Exchange." The Baltic Exchange is the market in London for selling coal, oil, grain, and timber. It is held in a large building in the City of London.

WHEAT:	West Australia (afloat).
	New South Wales.
	No. 1 Northern Manitoba (from Atlantic Ports).
	No. 1 Northern Manitoba (from Vancouver).
	South Australia (afloat).
MAIZE:	La Plata (*i.e.* River Plate).
BARLEY:	No. 3 Canada Western.
	Californian.
	Persian.
	La Plata.
OATS:	La Plata.
	No. 1 Canada Feed (*i.e.* for animals).
	No. 2 Canada Western.

Chapter IV

OUR FRIEND THE COW

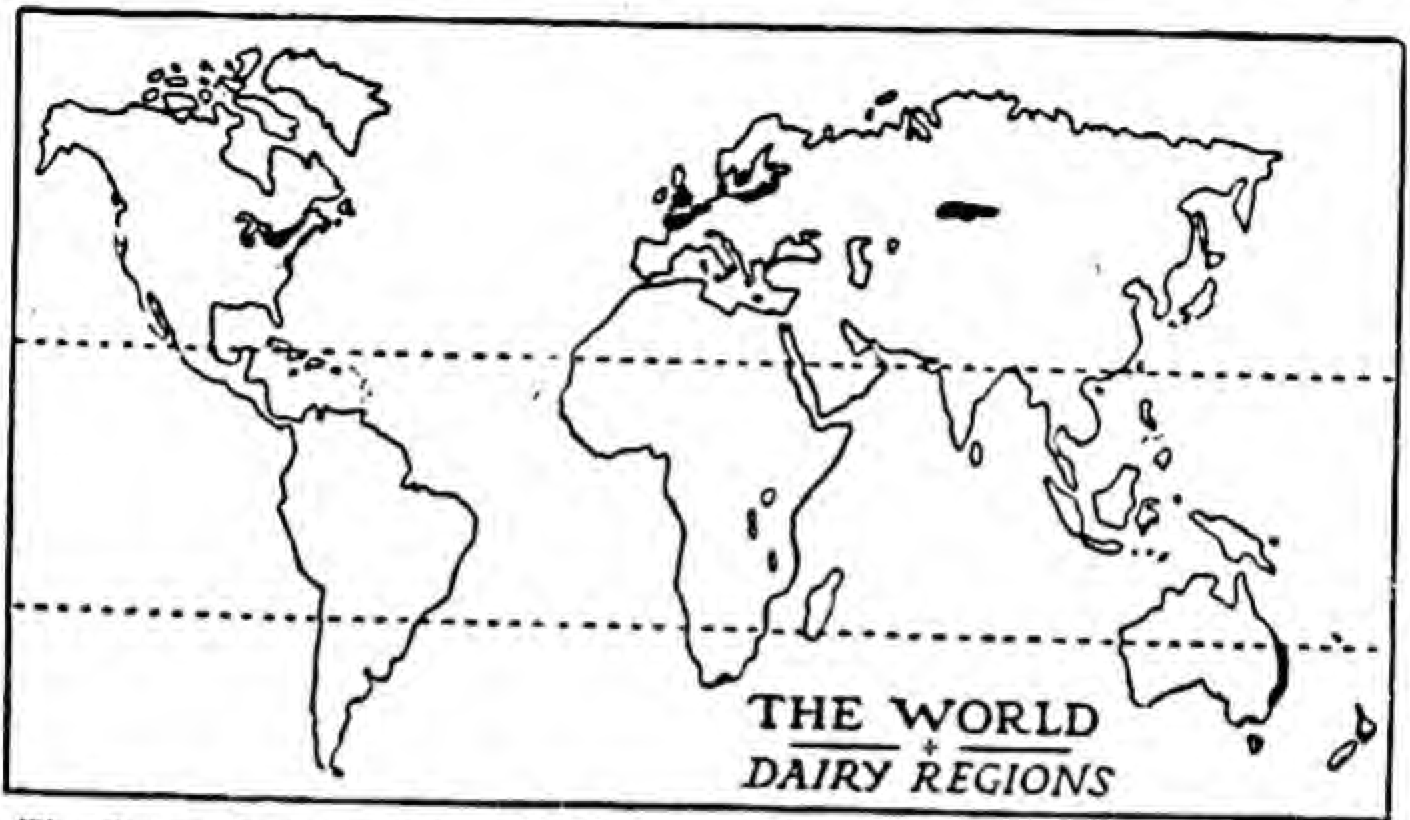
IT is a very long time since our ancestors first thought of keeping cows. In fact it is so long ago that it was already a habit when the story of the world first came to be written. The people of ancient Egypt used to keep cows. It was an old idea even to them.

Before that time the cow must have been half wild. The very first cattle that we hear about in Britain were quite wild. Their descendants are still to be found in the mountain islands to the west of Scotland. The island of Skye is famous for these cattle.

These wild cattle that roamed the hills of Britain, even before man set foot on these islands, had very wide horns. They were not very large, and had long shaggy hair. In every way they were very different in appearance from our modern farm cattle.

The cow became useful to man because it could provide a regular supply of milk. This was a great change from the food of the hunter, and was also good for children. Nowadays milk is a regular food of millions of people, both black and white.

Some races live almost entirely upon milk, or upon the cheese and butter which can be made from it. This is especially true of those races like the black herdsmen of



The Dairy Regions of the World are small, but very productive. They lie almost entirely in temperate latitudes, and depend upon good pastures with ample rainfall. Notice the great dairy region of Western Siberia, which produces very large quantities of butter. Dairying is also carried on extensively in country districts near large cities or densely populated industrial areas, to provide the daily supply of milk.

East Africa, or of the wandering Kirghiz herdsmen of the Russian Steppes, who keep herds of cattle for a living.

At first only those people who kept cattle were able to make use of the milk, but as time went on these people learned how to trade their milk or cheese for corn or other things which they needed. In some countries wealthy people were in the habit of keeping one or two cows in order that they might be supplied with fresh milk every day.

To-day the business of supplying milk has become so important that millions of people are employed in it. It has become a special job, and the dairy farmer nowadays is one of the most important members of the human family.

Of course, some places are better for keeping cattle than others. If the dairy farmer is to obtain plenty of milk, his cows must be able to obtain plenty of rich green food. The meadow lands of the earth are the best places for dairying,

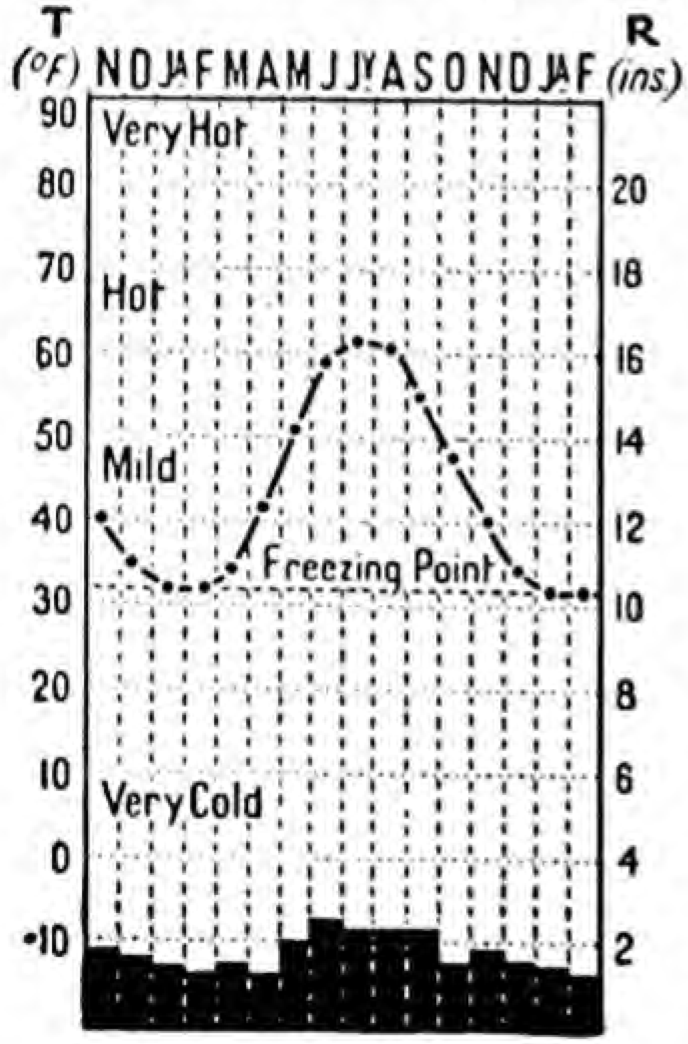
for there the weather is not too hot and there is plenty of rain to make the grass grow.

The best dairy lands also have a very mild winter and not too hot a summer, for cattle do not like the cold. They have no thick woolly coat like the sheep to keep them warm. It is also hard for them to find enough food out of doors during a cold winter, for, as we know, the grass does not grow much in winter time.

In the cooler dairy lands the farmers have to take a great deal of care of their cows during the cold weather. In Switzerland and in several other countries, including some parts of Britain, the animals are kept in barns during the winter. They also have to be fed during the winter time, and this is the expensive time for the dairy farmer.

Two hundred years ago farmers in Britain could only feed their animals upon hay during the winter, and so it was not possible to keep many cows. Nowadays, however, the cattle are also fed upon roots such as turnips and mangolds, which the farmer grows when he is not growing wheat in his fields.

Another very important food which is given to dairy



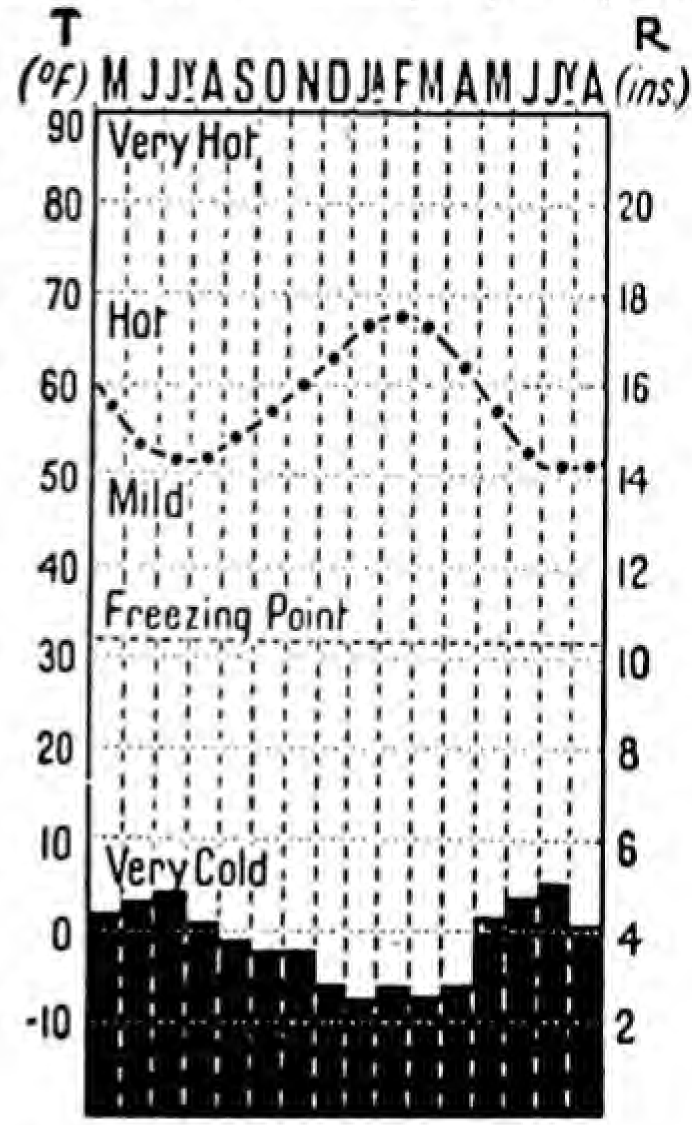
CLIMATE OF COPENHAGEN.

Denmark has a mild equable climate, such as is very suited for dairy farming. The winters are seldom very cold (which would mean more expense in winter feeding), and the summers are not hot. Rain is well distributed throughout the year, and this helps the pastures.

cattle is what is called "cattle cake." It looks like large flat slabs of thick cardboard, and is made from crushed seeds of different kinds. Many of these seeds are grown in very hot countries such as India. They are very oily, and the oil inside the seeds is very useful. Castor oil comes from seeds of this kind, so does colza oil, and linseed oil.

The seeds are crushed at large mills to squeeze out the oil, and what is left is pressed into large slabs of "cattle cake." One of the best kinds of "cake" is made from the seeds of the cotton plant, which grows in America, and in Africa and India.

Most of these foods are needed in lands where animal food is scarce during the winter. In some dairy countries they are not needed. In Australia and New Zealand, for example, the winters are so mild that cattle can stop out of doors all the year round, and there is always plenty of pasture. This makes a great deal of difference to the dairy farmers in those lands, and they can obtain milk more cheaply than in countries where the cattle have to be fed.



CLIMATE OF AUCKLAND.

Auckland is the centre of the New Zealand dairying region. Notice on the graph the warm, equable temperature, much higher than in the dairy lands of Europe, and the abundant rain throughout the year. The dairy herds find ample food out of doors all the year round under these conditions, and the yield of milk is therefore high. Compare this climate with that of Copenhagen.

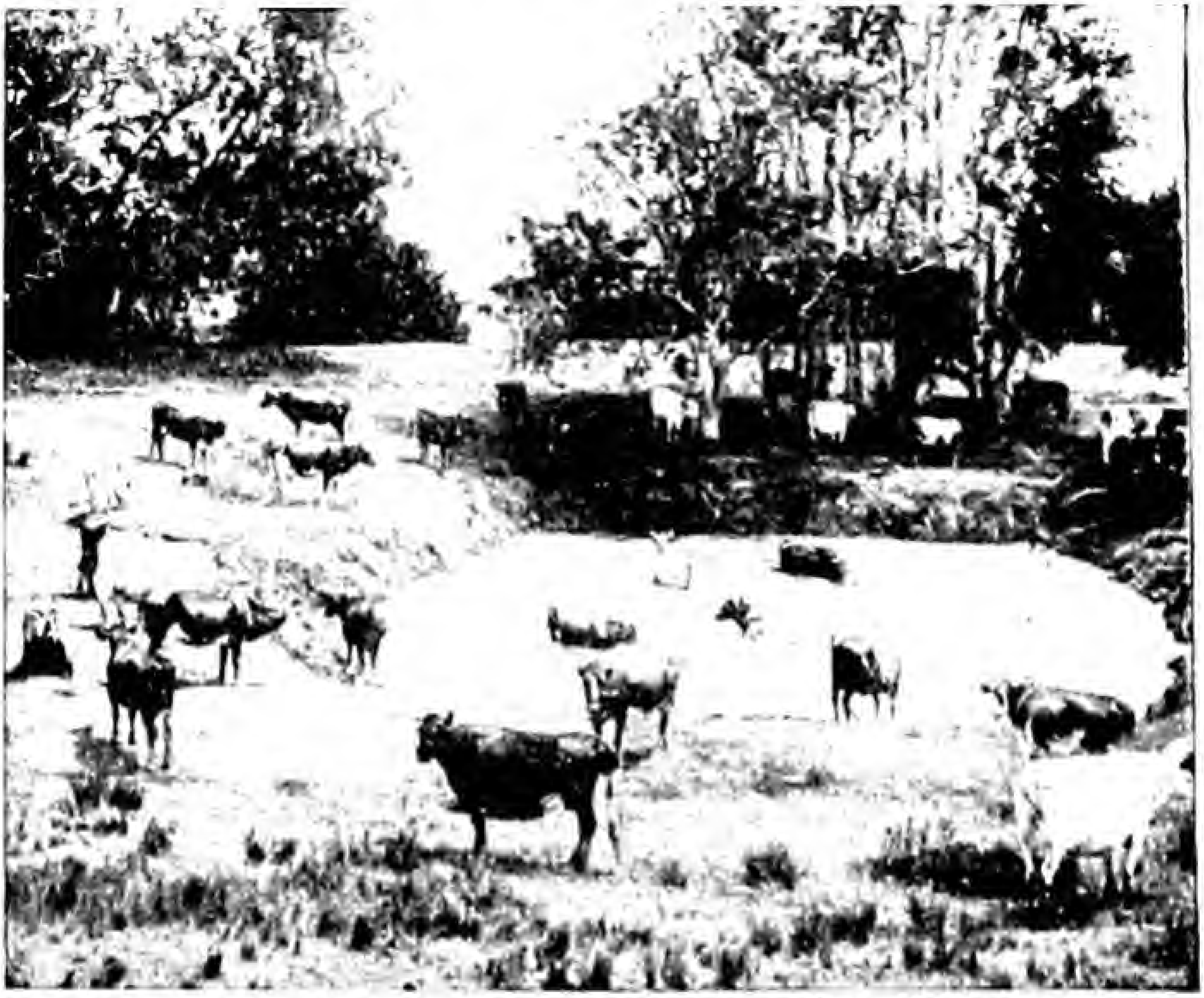


Photo., Commonwealth Govt.

AUSTRALIAN DAIRY CATTLE.

There is much dairying in South-east Australia, where the warm weather and ample rain ensure good pasture. The coast districts of New South Wales and Victoria are the most important dairying regions.

In some countries, too, especially in the crowded parts of Europe and North America, land is very dear. The dairy farmers near the big cities cannot afford to have large fields, and so many cattle have to be put into one field, and food has to be brought to them.

The most important dairy countries of the world are all near the sea in the temperate lands. Holland and Denmark are the most famous dairy countries of Europe. In both of these there are level stretches of rich meadow land upon

which the cattle can feed. There are rich meadows, too, in parts of Eastern Canada near the sea.

In these lands the farmers keep great herds of cattle which have been specially chosen to give plenty of milk. Of course, the farmers themselves cannot use all the milk which they obtain from their herds. Some of the milk is sold to people in the cities, but most of it is sent to factories to be made into butter or cheese.

Denmark is the greatest butter-making country. Dotted about among the dairy farms are large butter factories which are owned partly by the farmers. All the farmer has to do is to deliver his cream to the factory. In most cases the factory sends round large motor lorries to collect the cream from the farmers. The cream is separated from the milk in a very clever little machine called a "separator." At the factory the cream is churned into butter, which is salted and packed for sending to other countries. In normal times millions of pounds of Danish butter are sent to Britain every year.

What happens to the rest of the milk when the farmer has separated the cream from it? Well, it is used for feeding pigs. When mixed with meal and other food, milk makes a very good food for fattening pigs. Most dairy farmers also keep pigs, and in Denmark the pigs are sent to large factories where they are killed and turned into bacon. Thus Danish butter and Danish bacon are both famous all over the world.

In Holland, the Dutch farmers do not bother so much about butter. Instead they turn their milk into cheese. Most of the cheese is made on the farms, and is taken from time to time to the big cheese markets, which are held at different towns. The most famous cheese market in Holland is at Alkmaar.

Photo: Exclusive News Agency.

A DANISH CO-OPERATIVE DAIRY.

A busy scene outside a co-operative creamery in Zeeland. Milk from the farms is being delivered. It is in neat, attractive buildings such as this that Danish butter is made.

Dutch cheeses are round, and look like golden cannon balls. One kind, of which a good deal is sent to Britain, is red outside. As the whole of the milk is used in making cheese, the Dutch farmers do not keep many pigs, and Holland is not famous for bacon.

The farmers of Eastern Canada make both butter and cheese, and also fatten pigs for bacon and ham. New Zealand also sends butter and cheese to Britain. The dairy farmers in these distant lands would not be able to sell their butter or cheese at home, for there are not many people living there.

Photo : Exclusive News Agency.

DUTCH CHEESES AT ALKMAAR, NORTH HOLLAND.

These loads of golden globes are Dutch cheeses, ready for weighing at the great cheese market at Alkmaar, in North Holland. The cheeses arrive in barges from considerable distances, and are carried from the canal quays on these curious "sledges" to the weigh-house. Within the cheese market, the most important in Holland, the porters wear very picturesque, old-fashioned uniforms.

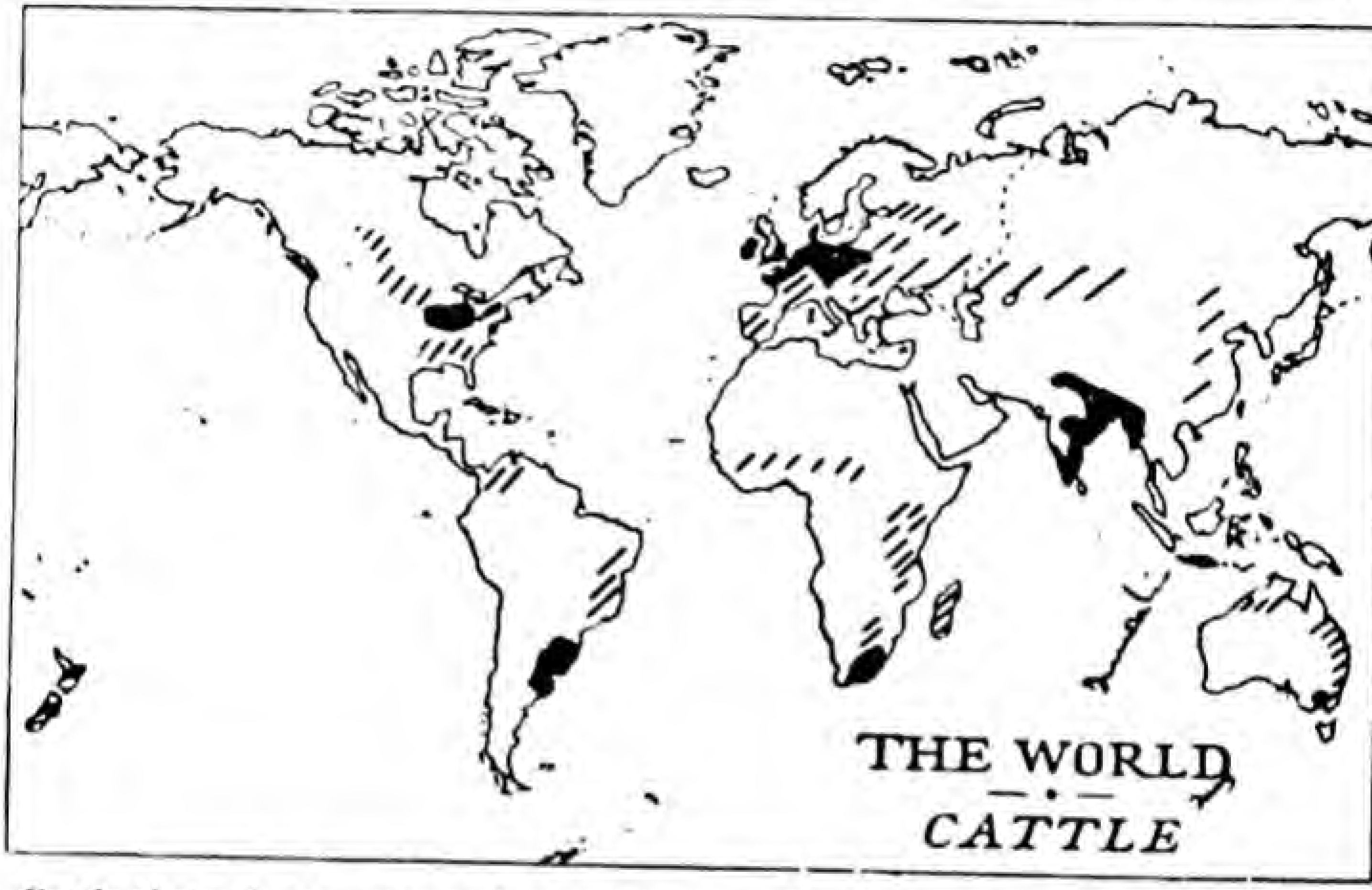
They are able, however, to send the butter or cheese to Britain because the cost for carrying goods across the ocean is so very cheap. It only costs one halfpenny to carry a pound of butter all the way from New Zealand to Britain—a distance of 12,000 miles.

Besides the low-lying meadow lands which are near the sea, mountain lands are also famous for their cattle. The people in countries like Switzerland and Norway are also herdsmen.

In such lands the cattle are kept in barns during the winter, and are fed upon hay or roots. Then, in the summer, the herds are taken up the mountains to the rich

pasture lands near the snow fields. Every summer, when the snow melts on the mountain sides, it leaves stretches of tender grass upon which the herds can feed. In Switzerland these mountain pastures are called "alps," and this word has given its name to the whole of the mountains.

In these mountain lands the boys and womenfolk help



Cattle thrive best on the rich grasslands, or savannahs, which are found in the summer rain regions of the world (see the climate graph on page 69). Broadly speaking, in the cool regions cattle are kept for dairying, in the warm regions they are fattened for beef, and in the hot regions they are used for transport or for farm work. The greatest cattle country in the world is India.

a great deal with the work, for sometimes the men have to be away from home. In Switzerland many men act as guides to the tourists who wish to climb the mountains. In Norway the men are away fishing.

Usually the family spend the summer months in a little hut upon the mountain slopes near the pastures. The cows are milked every morning and evening, and the milk

is made into cheese in a tiny dairy, built on to the hut. From time to time the cheeses, which, like those from Holland, are nearly always round, are sent down to the villages to be sold in the markets there.

In such a crowded land as Britain cows are kept everywhere, but some parts of the country are better for dairying than others. The West Country is famous for its dairy produce, and so is Ireland.

In Britain a great deal of the milk is sold by the farmers to big firms, who supply it to their customers in the towns. Each morning big motor lorries collect the milk in churns from the farms. It is then taken to the nearest depot. This is a group of buildings where the milk is tested, and then is put into great glass-lined tanks ready to be sent to the distant cities. The tanks travel either by road or by rail, and when the milk arrives in the city it is ready to be put into bottles to be sent round to the houses of the customers.

The milk which is sold in this way is always "pasteurized," that is, it is passed through an apparatus which kills the harmful germs which might be in the milk. Thus the city dweller can always obtain very pure milk. Of course, all this costs money, and so there is always a good deal of difference between the price the farmer is paid for his milk and the price paid to the milkman.

In Britain all the buying and selling of milk has to be done through what is known as the Milk Marketing Board. Every farmer who sells milk has to send his name and address to this Milk Board, which has big offices in London. If the farmer sells his milk to a big firm or "combine," he is paid for it by the Milk Board at a fixed price.

This price varies slightly between different parts of the country. Every six months the Milk Board decides what the price is to be in each district or "region." The big

Switzerland is an important dairying country, the cattle being pastured in summer in the high meadows or *alps* near the snow-line. In winter the animals must be stall-fed.

firms who buy the milk pay the Milk Board, and the Milk Board then pays the farmer. The farmer does not get all the money, for he has to pay for the cost of collecting the milk, and for various other things.

The dairymen who keep their own cows, and sell milk direct to their customers, also have to send their names to the Milk Board. Then each month they have to let the Board know how many gallons of milk they have sold.

For every gallon of milk which they have sold they have to pay a certain amount (usually about twopence a gallon) to the Board, and this money is used to pay the farmers a

little more for their milk. This is very necessary, for the farmer may only receive eightpence a gallon for his milk, while if he sold it from door to door like the dairyman he might get two shillings a gallon.

The English farmer also makes a small quantity of cheese and butter. The big milk firms have their own factories for making these products.

Milk is also " condensed " by being boiled down. Condensed milk is sold in tins, and can be kept for years if necessary. It is very useful in countries where ordinary cow milk is scarce. Milk can also be dried into a powder, which is used as a baby food.

Perhaps one of the most remarkable things which can be made from milk is a substance called " casein." This is made from curdled milk. The curds are dried and ground into a very fine powder. From this casein all kinds of things such as combs, coat buttons, beads, and umbrella handles can be made. Casein also makes a very good glue which is not softened by heat, so that it is used for aeroplane construction. Fancy gluing an aeroplane together with dried milk!

The modern dairy-farmer makes considerable use of machinery. The milking sheds are fitted with all kinds of equipment, and herds of more than twenty cows are usually milked by machines. This saves labour, and enables the milking to be done in a much shorter time than would otherwise be possible.

The larger dairies and milk depots also use a good deal of machinery for bottling the milk and for the making of butter and cheese. This all provides work for engineers in the factories which supply dairy equipment. Thus the dairy industry has become very important in our modern world, and gives employment to a large number of people.

Chapter V

THE SHEEP

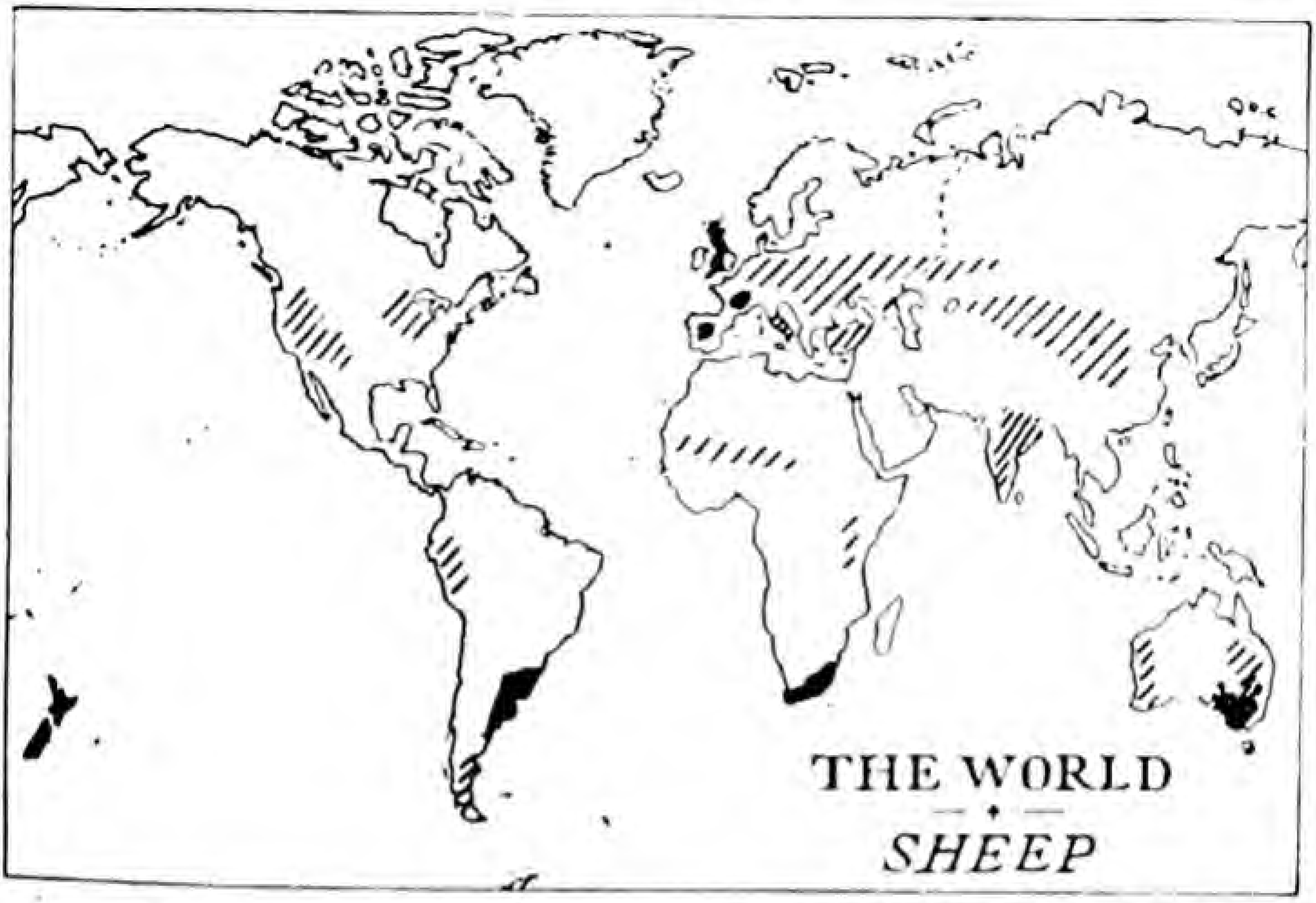
THE sheep is another old friend of the human family. The habit of keeping sheep is as old, if not older than that of dairy farming, although for a long while the animal was only really useful when it was dead.

The main object of keeping sheep seems to have been to obtain a supply of skins, which were needed for making warm clothes in a cold and draughty world. This use of skins for clothing has been practised since the dawn of time, and is still followed by various native peoples in the cooler parts of the world. It is, however, a somewhat wasteful habit, since an animal has only one skin. So it was not long before men began to use other substitutes, such as linen or cotton, made from plants.

These substitutes, however, were only of use in warm lands, while in winter a garment made from sheepskin was still the warmest and most durable form of clothing.

So the keeping of sheep still flourished, and in spite of the fact that three-quarters of the human race do not wear woollen clothing, there are several hundred million people who still look to the sheep to provide them with warmth, both by day and night.

Fortunately for the sheep, a discovery was made which has enabled the needs of mankind to be met without slaughtering the animal. This was that the thick woollen coating which grew on the outside of the sheepskin could be clipped off and woven into cloth. Just how and when



Notice that, apart from Britain, France, and Spain, the great sheep-rearing regions are in the Southern Hemisphere. For its population and size North America has very few sheep.

this discovery was made is not known; but, like most news of real importance, it spread rapidly, so that people all over the early world seem to have learned, much about the same time, how to shear sheep and use the wool.

To-day it is estimated that there are over six hundred million sheep in the herds of the world. Of these one-third are in Europe, and one-fifth in Australia.

The sheep is a small active animal, whose original home seems to have been in the uplands of Central Asia. Unlike cattle it will thrive in a hilly district, while its cousin the goat prefers the high mountains. This is very fortunate, for it enables men to use the hilly parts of their country, which are of little value to the farmer, for sheep rearing.

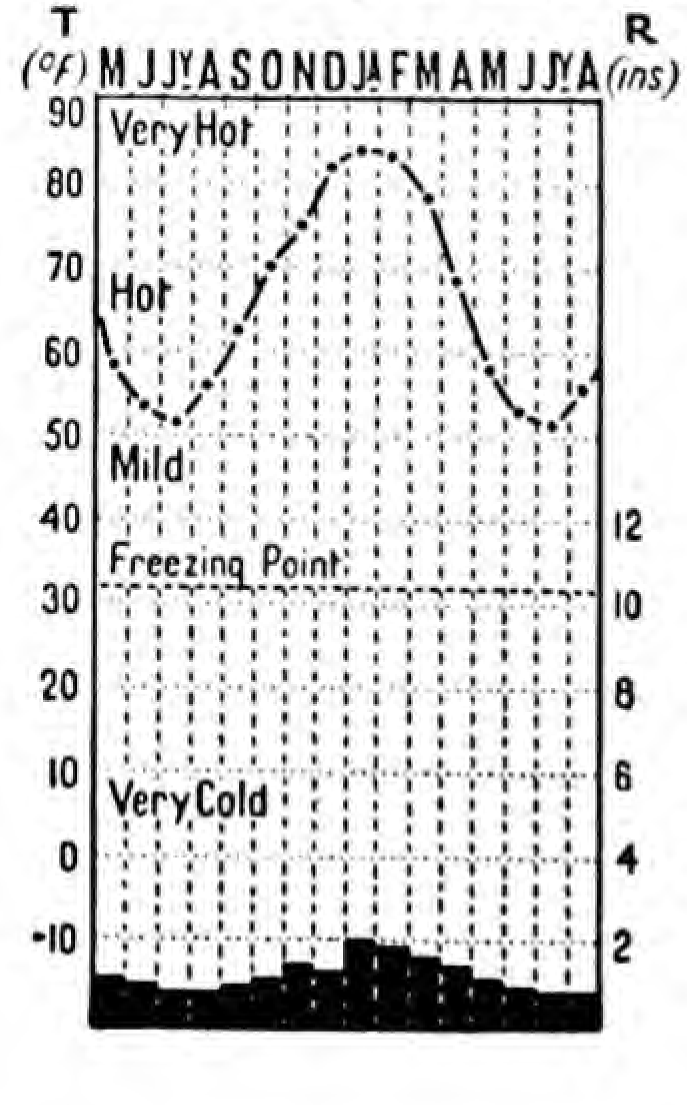
Sheep also prefer land which is fairly dry, and they are able to feed upon pasture which would be far too short for

cattle or horses. Hence sheep rearing can be carried on in the districts where there is not sufficient rain for arable farming, or where the soil is too poor to be worth cultivating. In Australia millions of sheep are reared out on the bush-covered plains of the interior, where the rainfall is not sufficient for arable farming.

The Karroo in South Africa is another dry region which supports millions of sheep, as do the stony wastes of Patagonia.

Thus we see that, as in dairy farming, climate and soil play a very important part in deciding which parts of the earth's surface may best be used for sheep rearing. Since the sheep is protected by a thick, woolly coat, it is not affected by cold weather so much as the cow. It can therefore remain out of doors in the coldest weather, and need not be kept in barns during the winter months.

Nor does hot weather upset the sheep so long as pasture and water are available. A very large proportion of Australian sheep are reared within the Tropics, and on

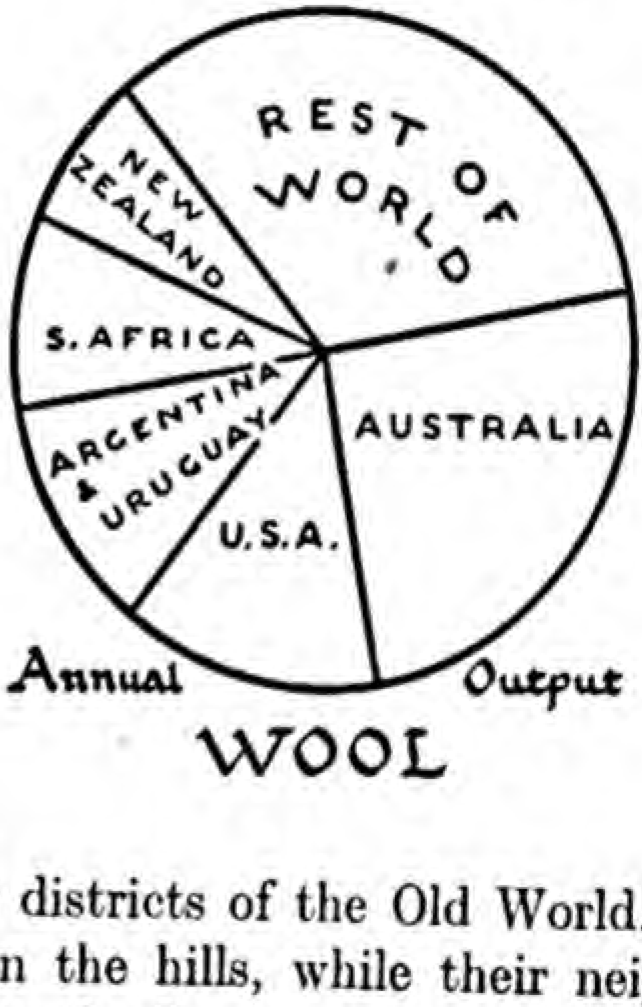


CLIMATE OF BOURKE, N.S.W.

Bourke is the centre of the sheep-lands of the Darling Basin. Notice on the graph the very high summer temperatures and the low, but fairly well-distributed rainfall. This means that pasture, though not plentiful, is usually to be found, but drinking water must be provided for the stock. Such a climate is of little use for mutton, and should be carefully compared with that of Christchurch on page 62.

many of the high mountain pastures in Asia the heat during the day is intense. It is this quality of being able to withstand extremes of temperature that causes the fleece of the sheep to be in such demand. There is no other material that can equal wool for this.

Thus the sheep is very important to man, and the work of rearing and caring for the sheep of the world gives employment to millions of people. Many of these shepherds



WOOL

live in the hilly districts of the Old World. They pasture their flocks upon the hills, while their neighbours on the lowlands cultivate the farms.

In Mediterranean lands, such as Spain, Italy, and Greece, sheep rearing is the chief occupation in the hills, and the folk from the hill villages trade their wool and sheepskins for the corn and fruit from the lowlands. In most regions it is necessary to keep the flocks upon the move, in order to reach fresh pasture, while protection from wild animals forms an important part of the work of the shepherd.

In the less crowded regions of the world wild animals

Photo: South African Railways.

A KARROO SHEEP FARM.

The Karroo is a vast extent of somewhat barren country 150 miles north-east of Cape Town. The ground is stony and covered with small, tufted plants, which provide the only pasture.

such as the wolf still abound, and though these seldom attack the flocks by day, the danger is considerable at night. So towards the end of the day the hill shepherd usually drives his flock into an enclosure or fold. In the East it is still a common practice for the shepherd himself to lie across the threshold at the entrance to the fold, in order to ensure that his flock shall be safe.

In some countries the flocks rove from place to place so that the shepherds lead a wandering life. Thus for a greater part of the year the herdsmen may be away from home, while some of the shepherd peoples of the world have

no fixed home, but live in tents and spend the whole of the time with their flocks. The dwellers on the great steppes and upland pastures of Asia live in this way.

Such people supply wool and skins to their neighbours, and attend great annual markets for this purpose. Often the wool is partly manufactured, or may be beaten into felt from which blankets, curtains, caps, and even boots are made, while the sheepskins may be dyed and made into various articles of clothing.

Among the more civilized peoples of the world, sheep rearing is one of the ordinary activities of the farmer. Not only can he sell the wool, but the animal itself supplies meat of good quality. For this reason the modern sheep, such as may be seen in our fields to-day, is what may be called a "dual purpose" animal. It is reared for mutton as well as for wool.

There are many varieties of sheep, each taking its name from the district in which it was first reared, and each having special qualities. South Down sheep, as the name tells us, are produced on the South Downs. Lincolns or Leicesters come from the chalk hills in those counties, and yield very fine wool. Mountain sheep, such as are reared in Wales, are rather small, but produce good mutton.

Where sheep are reared on farms, as they must be in a crowded land such as England, they need especial care. Disease is much more common than among flocks on the wide open spaces of Australia or South America. The shepherd has to be a rough doctor, able to attend to the ailments of the animals under his care.

Each day the flocks are counted, and any individual sheep which seem ill are given attention. One of the most common diseases among sheep is foot-rot, especially where the fields are damp and the animals are crowded. At

certain times of the year the flocks are pastured on the open fields, or are allowed to wander over several fields. At others, the sheep are penned in hurdles, to prevent them wandering, and are allowed to eat certain green crops such as mustard, which have been specially grown for them. As each area of the field is eaten off, the hurdles are moved to enclose a fresh area.

The most anxious time of the year for the shepherd is during the lambing season. Not only the little lambs, but also their mothers, need careful attention. The shepherd has to be out at all hours caring for his flock. On a large farm in a sheep-rearing district such as Kent, several hundred lambs may be born within a few weeks, and this means a great deal of work.

On most farms sheep have to be fed during the winter months, but on the hills the animals may go right through the winter without any other food than their pasture. A little hay may be put out when the snow deeply covers the ground.

All sheep are dipped, usually twice a year, in a mixture containing poison to kill insects or " ticks " in the wool, and to destroy germs. Shearing usually takes place in the summer, and for this machine clippers are used. Frequently big farmers may shear for their smaller neighbours.

In August the lamb sales begin, and farmers buy lambs to make up their flocks. Fat sheep are also sent to market, and from then until Christmas the markets of the countryside are fairly busy. Owing to the low price of wool, English farmers rely more upon fattening for market than for shearing. This is because the sheep farmers of South Africa and Australia go in for wool production, and can supply as much wool as is needed by the factories.

Sheep farming in these southern lands is therefore rather different from sheep farming in England. Huge

Photo: Commonwealth Govt.

PRIZE AUSTRALIAN MERINO RAMS.

It is from animals such as these that the vast herds of Australia's millions of sheep have been reared. The merino, whose home is on the arid plateau of the Spanish Meseta, is a small animal needing but little food, but having a very fine, heavy fleece. Conditions in Australia suit this type of animal.

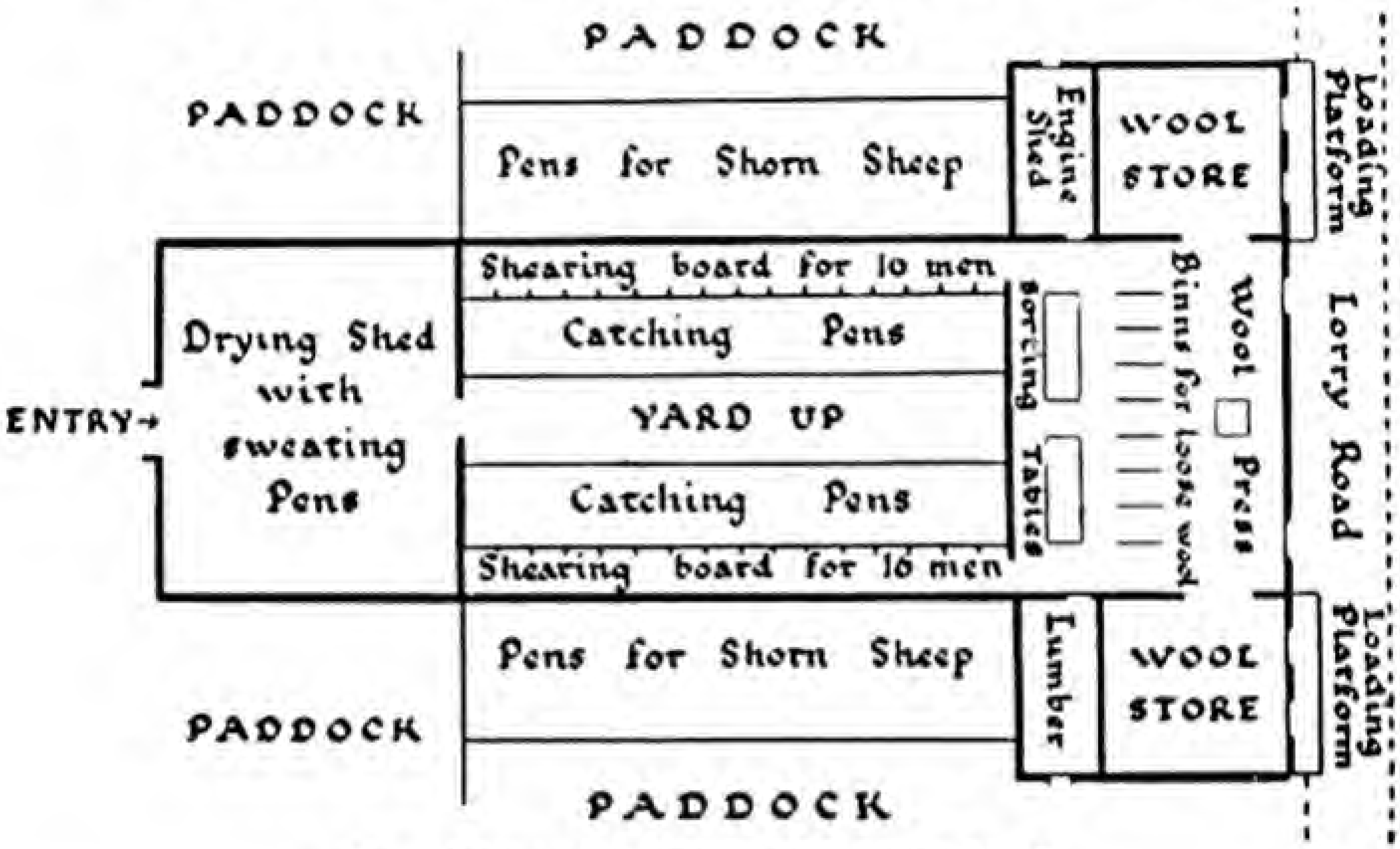
"runs" of open bush country are enclosed by rabbit-proof wire fencing. The average size of a sheep-run in Australia is about a thousand acres, but there are more than seven hundred runs each of which is over 100,000 acres, while some are as large as an English county. On such a run there may be 50,000 sheep.

The number of sheep on a run depends upon the pasture. Those stations which are farthest out, in the drier parts of the country, are the largest and carry fewer sheep, for their size, than the smaller runs near the farmlands.

No attempt is made on such runs to rear sheep for mutton. A dead sheep is worth as much as its skin, and no more. The Australian sheep farmer concentrates upon

wool, and for that reason he rears a breed of sheep called "merinos." The Australian merino is very hardy, and produces a heavy fleece of good wool. It is descended from a herd of Spanish merinos that were sent to South Africa two hundred years ago.

The flocks are watched by boundary riders—men who



Plan of typical Australian Shearing Shed.

ride round the paddocks and spend most of their time out in the open. At shearing time the flocks are driven into the station, and penned in large "yards" ready for shearing.

This work is carried on by shearers, who travel from station to station. Each man shears from one hundred to two hundred sheep in a day. They are well paid, and often travel from station to station in their own cars.

The work of shearing is done within a large building called the wool shed, arranged as shown in the plan. The sheep are first driven into a drying shed which holds enough sheep for one day. It is important that the wool should be

quite dry when it is shorn, so the sheep are driven in overnight.

Shearing starts at six o'clock in the morning. Some of the sheep are driven into the "yard up" and so into the pens. Along the walls of the shed runs the shearing board, a low platform on which the shearers work. After being sheared each sheep passes out into another pen, and so finally returns to the paddock.

At one end of the shearing shed is the sorting room, where the fleeces are examined, the bad parts are picked off, and the wool is classified according to how it is expected to spin. This classification is one of the most important jobs on a big sheep station, for the buyer for the factory in Europe relies upon the wool being properly sorted. It is very seldom that any mistake is made by the Australian wool-sorter.

The wool is now packed in bales of about 350 lb. each, bound with hoop-iron. They are then sent to the ports for shipment to Europe. During the season big auctions are held regularly in Sydney, Melbourne, and Geelong. These auctions are attended by agents of British firms who buy the wool for the mills in Yorkshire or Scotland.

In South Africa most of the wool is auctioned at Port Elizabeth, which is the nearest port to the Karroo, South Africa's great sheep-rearing area.

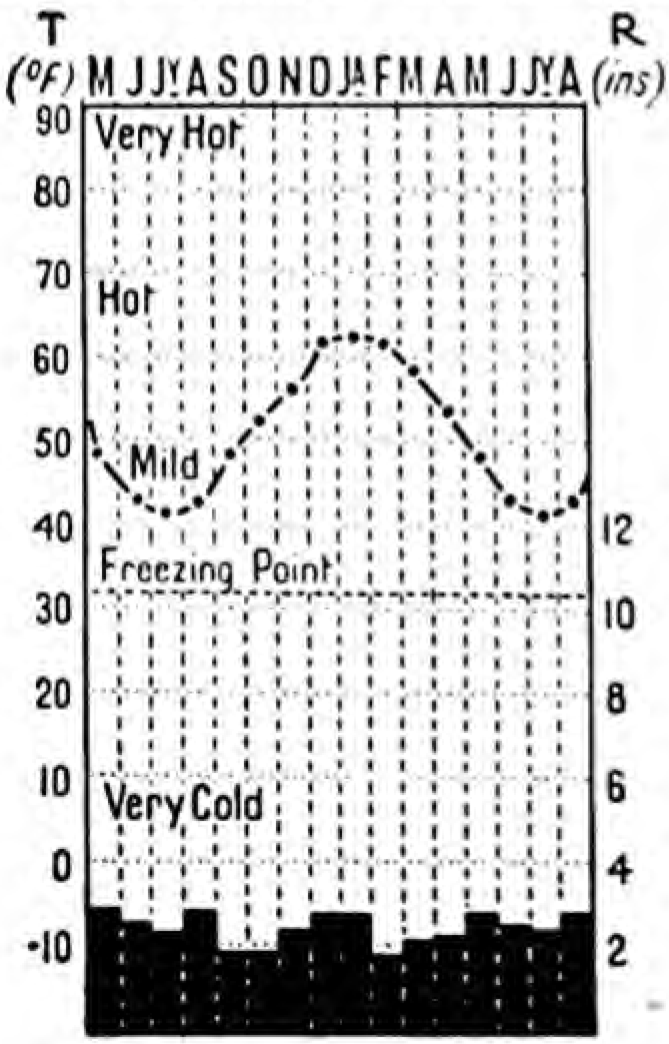
From Australia sailing vessels go via Cape Horn, owing to the westerly winds. Cargo steamers usually travel via Cape Town, as by this route they avoid paying heavy canal dues.

The largest sheep area in Australia lies within the great curve of the eastern mountains. From here the land slopes gently down towards the centre of the continent, and is drained by the river Darling and its tributaries. Most of the wool is collected at centres such as Bourke or Menindie, whence there are railways to the ports.

New Zealand is another important sheep producing country. Here, in the drier eastern slopes of both islands, sheep are reared both for wool and for mutton. Up country the merino is reared, but the famous Canterbury lamb is produced from a dual-purpose animal called the Corriedale.

Another big sheep-rearing area is in Argentina, in South America. Here, in the drier and more southerly districts of the pampas, and extending southwards into Patagonia, there are big sheep farms. As in New Zealand, the sheep are reared both for mutton and for wool. Near the Plate estuary there are huge chilled meat works called "frigorificos" where the animals are killed, skinned, and the carcasses are dressed for export. Many thousands of sheep can be dealt with in a single day, and a large proportion of the "foreign" mutton which is sold in our shops comes from Argentina. Buenos Aires is the chief port.

The sheep of Patagonia are reared mainly for wool, which is collected by coastal steamers from a number of small ports.



CLIMATE OF CHRISTCHURCH, N.Z.

The graph shows the climate in which Canterbury lamb is produced. Notice that the weather is always warm but never too hot, while there is an ample and well-distributed rainfall. This provides excellent pastures and enables stock to be fattened. Compare this climate with that of Bourke, N.S.W. (page 54), which is in a wool-producing region. Christchurch and Napier are the chief New Zealand ports for wool.

CHAPTER VI

BEEF AND LEATHER

As well as rearing sheep for mutton or wool, the modern farmer also goes in for "store" cattle, which are fattened for beef. These pay better than sheep, for most people prefer home-grown beef. The rearing of cattle, however, is not such a simple business as it used to be. Certain parts of the world are convenient for cattle rearing, while other districts may be better for fattening the animals. In fairly crowded lands such as Britain the animals may move from one district to another every few months.

The rearing of store cattle also differs considerably from breeding dairy cattle. The dairy farmer aims at producing milk and keeping cows, whereas the cattle breeder is not interested in milk, and so he goes in for cattle of a different kind.

The finest beef cattle are reared in the hills in Scotland, and yield the celebrated "Scotch beef." Another famous breed is the Shorthorn, of which most of the great herds in Argentina, South Africa, and Australia are composed. On the windswept cattle ranges of the Far West of Canada and U.S.A., where the winters are very severe, a hardy breed called Herefords are reared. These animals have a thick coat of hair which helps to protect them during the bitter weather.

On the great overseas ranches the animals graze on the rough pasture lands which have not yet been taken up by the arable farmer. The stock riders keep an eye on the move-

Photo: Exclusive News Agency.

ON A SOUTH AMERICAN RANCH

South America is the world's greatest cattle-ranching country, and produces some of the finest beef cattle, which are reared on the vast grasslands in the Plate River basin and in Venezuela. This photograph shows typical beef cattle being watered on a Venezuelan ranch on the llanos of the Orinoco.

ments of the herds, and do not allow them to wander beyond the limits of the ranch. In North America most calves are born in April. In July the herds are rounded-up, the young animals are branded and their horns removed. Then, in September, the yearlings or two-year-olds are picked out and driven off to the stockyards of the nearest railway town.

Each ranch has its own mark or brand, which is burned with a hot iron on the flank of each animal. This enables the beasts to be traced should they wander away and join another herd. The brand consists of one or more letters and lines arranged in a simple pattern that cannot be easily altered. A common brand is a letter within a triangle or a circle, or two letters separated by a single line or " bar." The ranch may become known by its brand. Thus, " Circle

Y," or "Y Circle," means the letter Y within a circle; "K Triangle" is a K within a triangle, and so on.

Some of these western cattle ranches are of tremendous extent. One of them, the King Ranch, carries 200,000 head of cattle, or more than in the whole of Aberdeenshire; but huge herds are now the exception.

From the stockyards of the cattle town the animals are sent by train to farmers, who feed them upon green maize and other fodder until they are ready to be sent to the slaughter houses of the big cities. In the corn belt of the United States every city has its meat-packing factories, where the beef is canned. There is also a very big demand for "baby beef," as it is called, which is the meat from young animals specially fattened.

Chicago, on the shore of Lake Michigan, is the greatest of the meat-packing towns. Its stockyards cover more than five hundred acres, and these are merely the "waiting rooms" for the big packing houses. These yards are always full, and as fast as the animals are sent into the slaughter houses, trainloads of others take their place.

Within the packing house each animal is inspected by veterinary surgeons to ensure its freedom from disease. It is then painlessly slaughtered, and the carcass is swiftly dealt with by machinery. The skin is sent to one store, horns and hooves to another, while the meat itself is cooked, packed into tinned cans, which are sealed and then re-heated for half an hour to destroy any germs that might otherwise affect the meat and turn it "bad."

Almost every part of the animal is used. The horns and hooves are made into glue, the skin is made into leather, the fat is shredded for suet, the kidneys are canned separately and will finally reach their last resting-place within a "steak and kidney" pie, perhaps on the other side of the

Photo: Canadian Govt.

A CATTLE RANCH IN SOUTHERN ALBERTA.

In the rain shadow of the Rockies are valuable pastures where thousands of head of cattle are reared, mainly for beef or leather. In Canada the quality of the animals is being improved by careful breeding from pedigree herds on such up-to-date ranches as this.

earth. The tails become ox-tail soup, while the bones are manufactured into phosphorus, or are transformed into bone ash, which, when ground up with china clay, produces the finest porcelain. Your best tea service may owe its translucency to a bullock's bones.

In Canada ranching is slowly changing. The farmer has steadily advanced over what once were wide open ranges. Now the western rancher goes in for fewer animals of a better quality. The old "cow towns" have changed. No

longer do the cattlemen ride in, with their "chaps," high-heeled boots, and broad-brimmed Stetson hats. Instead, the beasts are tended by men who probably have been trained at a government college. If the rangers go into town it is by motor car; the skyscraper hotels have taken the place of the old saloons where the cattlemen played poker.

But if cattle ranching is changing in Canada, it is still carried on in the old way in Mexico and Argentina, and in South Africa and Australia. In the autumn of 1935 there died in Adelaide a man who was known as Australia's "Cattle King." Nor was the title an empty one, for at the time of his death he owned about 26,000,000 acres of grazing land, or about 40,000 square miles—roughly the size of Scotland and Wales.

The cattle lands of Australia are mainly in the north in the rich tropical grasslands of Queensland and North Australia. The beasts are reared in the "back blocks," far beyond any town or settlement. Then, after the annual "round-ups," the herds are moved to the richer pastures near the coast. Some of the herds may even be driven slowly southwards along the great "cattle track" across the continent to Adelaide, in South Australia. Flowing wells, opened up by the government, provide water along the route.

Large freezing works have now been established near the ports, and these are open for three or four months of the year according to the number of animals ready for slaughter. This depends, in turn, upon the rain. Northern Australia has seasonal rainfall, most of the rain coming during the hottest months. The amount varies, however, from year to year, and if the rain is below the average there is less pasture for the herds. Cattle are far more dependent upon water than sheep.

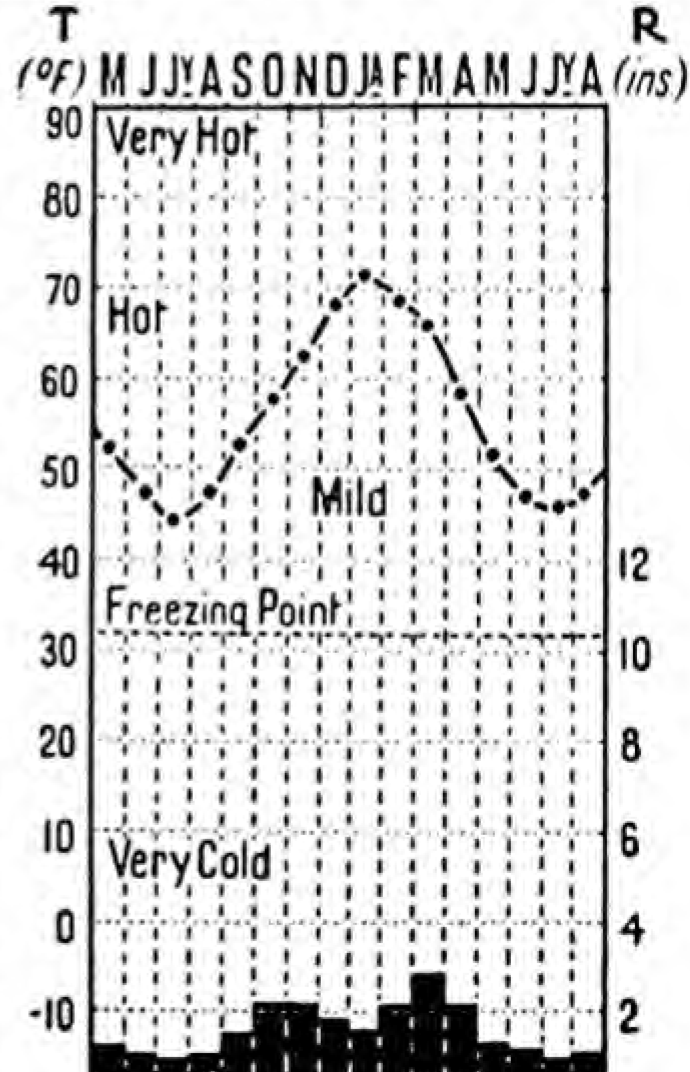
WATERING CATTLE IN CENTRAL AUSTRALIA.

The great problem in Central Australia is to provide water for the stock. There is usually plenty of pasture. This shows how water is supplied from an artesian bore-hole to the drinking wells. There are chains of these wells along the stock routes, right across the continent. This well is at Maxwelton in Queensland. The country around is typical Australian bush in the back blocks.

Australian beef is usually frozen, rather than canned, and the hides are exported for making leather. Freezing does not improve the beef, but it enables it to be kept for many months, or even for years. Beef which reaches England from South America is only "chilled," *i.e.* the temperature is just a little above freezing-point. Chilled beef is better than frozen beef, but such meat has to be eaten within six or eight weeks after leaving the works. As the ocean journey from Australia takes at least seven weeks, it is not possible for them to sell chilled beef, so it has to be frozen. New Zealand beef is treated in the same way.

By far the greater part of the beef imported into Britain comes from the Argentine. There are several reasons for this. In the first place the vast grass-covered plains known as the pampas have a splendid climate for cattle. The weather is never bitterly cold in winter as in North America, nor is it intensely hot as in Australia, while droughts are practically unknown.

Then, too, the people who reached this part of the world and settled there, knew a good deal about cattle. For centuries the Spanish have bred cattle especially for bull-



CLIMATE OF BAHIA BLANCA.

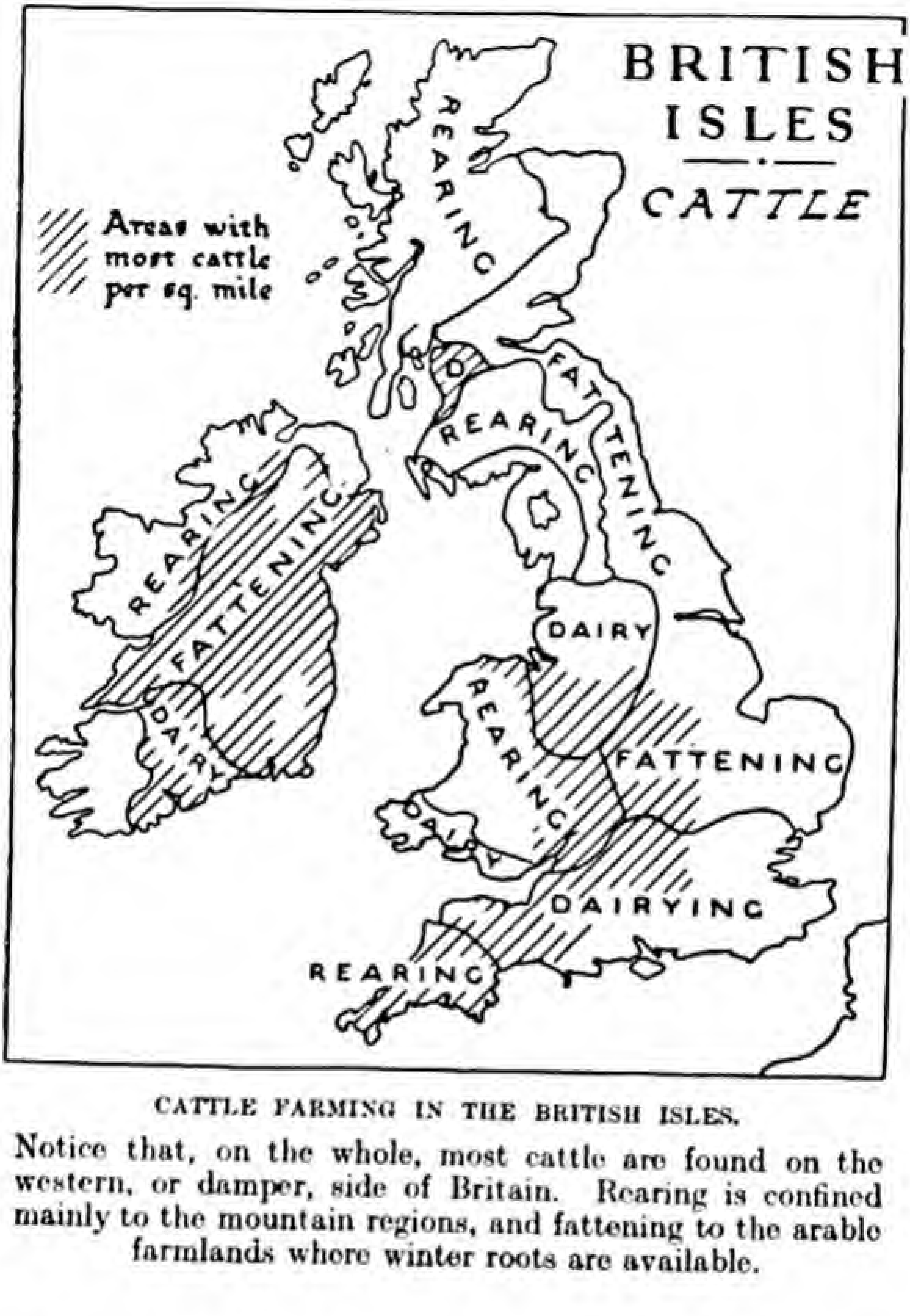
The graph shows the climate of Bahia Blanca, one of the southern ports of the pampas. Notice that most rain falls during the summer months, providing the pasture with moisture when it is most needed. The weather is never cold. Such a climate is typical of good cattle country.

fighting, and the average Spaniard can "size up" a bullock more accurately than anyone else upon earth. It was natural, therefore, that the great Spanish landowners in the Argentine should begin to breed cattle, and to-day the vast herds that are reared on those warm southern pastures around the mouth of the river Plate are the finest beef-cattle in the world.

When the cattle trade with Europe first began the animals had to be exported alive. The discovery of a method of freezing the meat, and later, of chilling it, made it possible to increase the trade enormously. The crowded millions of factory workers in England needed cheap meat, and the Englishman has always been partial to roast beef. At the same time the beef had to be good, so the cattle-kings of the Argentine sent their agents to England to buy the finest cattle that could be obtained. At every show the prize animals were bought up, thousands of pounds being paid for a single champion. From these animals the present herds in South America have been reared.

The South American cattle ranch is called an "estancia." It consists of a number of large paddocks enclosed by wire fences, surrounding a low-built, white-walled house which is the home of the manager. The owner probably lives in a palatial home in Buenos Aires or Montevideo. The work of looking after the beasts is carried on by "gauchos," who are half Spanish, half Indian. These half-breed cowboys spend most of their time with the herds. Their wives and families live in miserable tumble-down shelters, tucked away in some corner of the estancia. They cannot read or write, and earn miserable wages, but they are born cattle men.

Owing to the evenness of the climate the work on an estancia goes on throughout the year. Every few weeks, trainloads of animals are dispatched to the big ports, where



CATTLE FARMING IN THE BRITISH ISLES.

Notice that, on the whole, most cattle are found on the western, or damper, side of Britain. Rearing is confined mainly to the mountain regions, and fattening to the arable farmlands where winter roots are available.

the meat-works or frigorificos are working at full pressure. Great care is used in grading the meat. Each carcass is cut up into quarters, which are sewn up in two layers of thin cotton cloth, enclosed in a brown bag, and then hung in the cooling rooms until they are transferred to the ships which will bring them to England.

The frigorificos of Buenos Aires can deal with several

thousand head of cattle every day, or nearly ten times that number of sheep. Montevideo, the chief city of the little state of Uruguay, on the opposite bank of the Plate, can deal with nearly as many more. The whole of this vast output is carried by vessels which are specially equipped with cold-storage holds. The run to England takes eighteen days, most of the cargoes being landed at London or Liverpool.

South Africa has also begun to produce chilled beef, but at present the amount sent to England is very small. There are so many cattle diseases and insect pests there that it is difficult to improve the herds. Cattle sent from other countries usually die, and although the South African ranches are doing their best, it will take many years before the quality of the beef even approaches that from the Argentine. Most of the South African beef is bought by Italy or France, which also take most of the frozen beef from Australia. South African beef is sent from Walvis Bay, where a chilled meat works is in operation.

The amount of beef sent to Britain from overseas amounts to about 2,000 tons per day. English farmers supply almost as much again. The work of supplying home-grown beef is rather more complicated. Usually the animals are raised on the comparatively poor hill pastures in Scotland or the West Midlands. When about six months old the young animals are sold at the nearest market, or through a cattle dealer, and move to a better feeding district. After another few months the animals will change hands again, and this may happen four or five times, until at length they reach the neighbourhood of a large town or city. Here they may be finally fattened for the butcher, being shut up in stalls or yards and fed upon oil-cake and roots such as turnips. The chief market in Britain for meat is Smithfield in London.

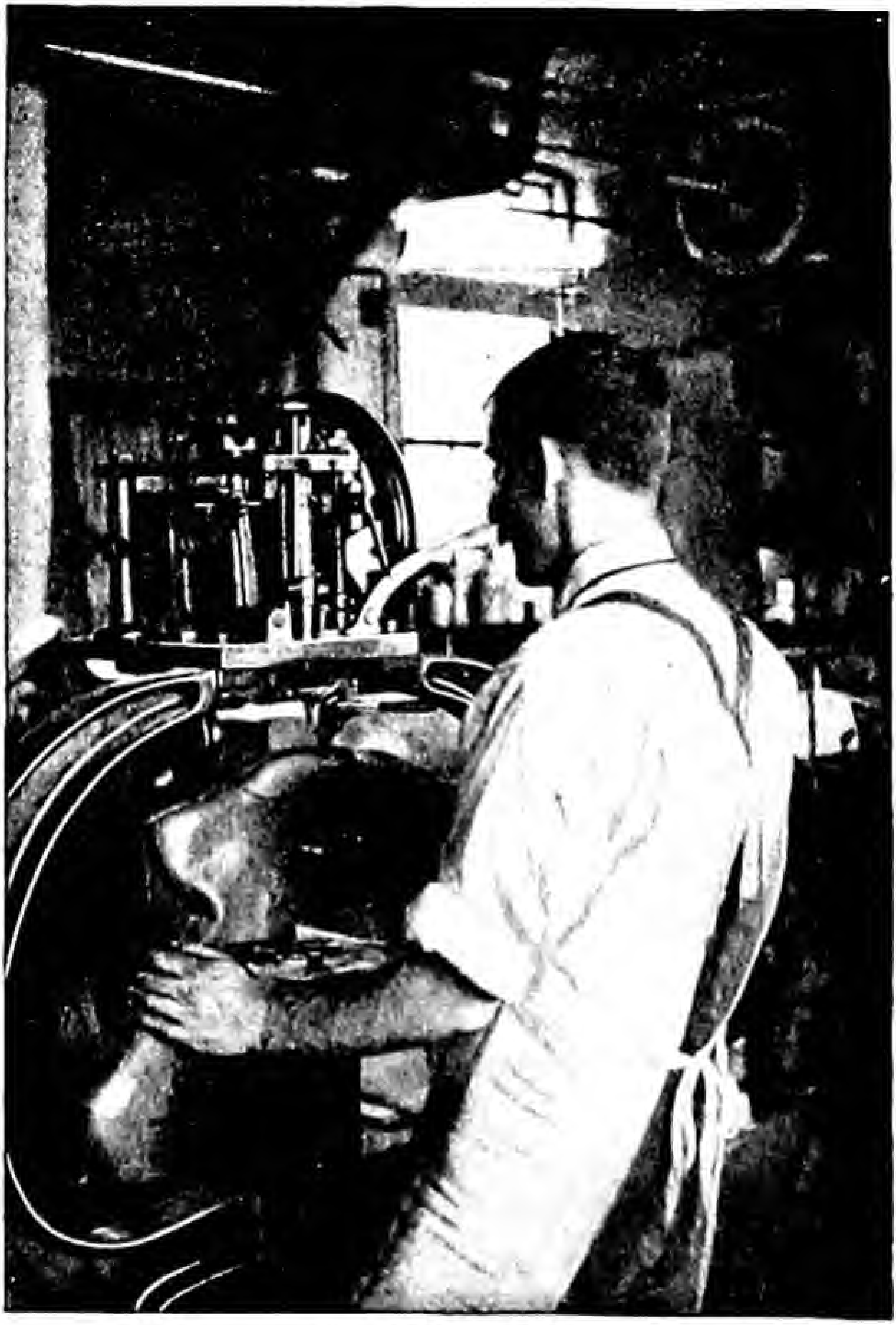
This movement from place to place is made possible by the use of road and rail transport. Big contracting firms will move the beasts in large motor lorries over distances which were out of the question when the animals had to be driven.

Although we might think that beef and milk provide the most important reasons for keeping cattle, yet more than half the cattle of the world supply neither. Instead, the animals are used for farm work or for road haulage, while in other instances they are kept for their skins. India is the greatest cattle country in the world, more than one-third of the cattle of the world being found there, yet the Indian peoples are vegetarians and would not eat beef if it were offered to them. To them the ox is a useful servant and beast of burden, while its skin provides a material which is very useful to the rest of the world.

The true Hindu will not touch leather, for it is to him unclean. Thus the Hindu boy wears sandals made of grass rather than of leather, and he will not play football with a leather ball, nor cricket except with a composition ball. These little prejudices may seem curious to us, but they are very real. They are the more remarkable in a land where there is a cow or bullock for every two people.

The use of skins was one of the very earliest inventions in the history of the human race, but skin and leather are two very different things. The hide of any animal rapidly stiffens, and until it is " tanned " it is of little value. The process of tanning converts the skin from a hard, stiff substance to soft supple leather.

To do this the skin has to be carefully soaked, scraped to remove any hair or flesh, and soaked again in chemicals. The substance which helps to change the skin into leather is found in the leaves and bark of certain trees or shrubs. In



IN A BOOT FACTORY

In the making of boots or shoes the article is made in several stages, each by different workmen who are skilled at their own particular job. Here the welt, to which the sole will be fastened, is being stitched to the upper.

Britain, oak bark is used, but most of the tanning liquids are prepared from wattle bark.

There are many kinds of wattle, which is a native of Australia, but is now grown extensively in South Africa. The tanning requires a great deal of skill, and is usually carried out in large tanneries in districts where supplies of the needed chemicals and oil can be obtained. Before the leather is finished the skins may be split into several thinner layers. Warm oil is also rubbed into the leather to make it pliable. The folk who do this work are called "curriers."

Leather is very tough and hard wearing. It is used all over the world, except in India, for boots, shoes, or sandals. It is the only satisfactory material for saddlery, straps, and harness. In some cities, such as Northampton in England, or Cincinnati in America, the leather trade gives employment to tens of thousands of workers.

In addition to its uses for shoes and harness, leather has been used for the upholstery of furniture for thousands of years. The manufacture of special leathers, of different colours and textures, is most important, and vast quantities are used for the interior of motor cars.

Other kinds of leather are used for bookbinding. The Arabs have been skilled in the manufacture of soft, coloured leathers for centuries. The leather known as "morocco" is prepared from goat-skins.

The demand for leather for upholstery and for bookbinding is so great that a big industry has grown up in the manufacture of imitation leather. This is made from heavy, closely-woven cotton cloth, which is dyed and covered with an oily layer of a paint-like substance. The fabric is then dried, baked, and polished. As much as a hundred million yards of imitation leather of various kinds is used every year.

Chapter VII

WHAT WE DRINK

If all the sky were paper,
  And all the sea were ink,
And all the trees were bread and cheese,
  What should we do for drink ?

THIS drinking question has always been a problem. We can go without food for quite a long while without anything more than discomfort, but we cannot go without drinking for more than a few hours without becoming ill. Fortunately, owing to a most efficient distillation and filtering process, aided by a wonderful system of distribution, there are very few parts of the earth without a good water supply.

Evaporation from the sea and other places where water has collected on the surface of the earth, ensures that absolutely pure water is secured in the clouds. The winds carry these water supplies to the most remote corners of the earth, where the water, still absolutely pure, is released as rain. Upon reaching the ground the water flows along channels that, in the course of centuries, it has worn out for itself, or soaks into the earth to reappear a little farther away as springs or wells.

Mankind has made use of this provision by building homes as near as possible to a water supply, and, in general, water is still the main drink of the people upon the Earth.

Photo: Donald M'Leish.

A VILLAGE PUMP IN NORTHERN ITALY.

In Mediterranean lands the water supply during the long dry summers is very important. In most of the smaller towns and villages the household supplies come from a single well or spring. This Italian Jack and Jill are fetching their pail of water from a village pump at Orta, near Lake Orta.

Nowadays in crowded lands, where tens of thousands of people are herded together in streets of box-like houses, and where the water is likely to lose its purity because of the work or habits of the dwellers, it has become a serious matter to provide a good water supply.

Every city and town of any size has its own organization to supply pure water, while all but the smallest villages are usually linked with the nearest town supply.

In most towns the water is obtained by pumping from very deep wells. Bore holes, a few inches in diameter, are drilled through rocks until water is reached, perhaps at a depth of several hundred feet. Pumping machinery is installed at the top of the bore holes, and the water is pumped to a large tank or reservoir holding thousands or even millions of gallons.

From the reservoir the water flows along large pipes or mains beneath the surface of the streets. Smaller pipes carry it to the houses, and so when we want water we have only to turn a tap to obtain it. We can be certain that the water is fit to drink because the engineers at the waterworks are able to test it, and, if necessary, purify it.

Impurity in water is usually caused by what are called "bacteria." These are tiny living creatures which swarm everywhere. They are found in the soil, in the air, and in both plants and animals. A few thousand of them will go on the head of a pin, and they multiply so quickly that even a single germ may become as many as several million within twenty-four hours.

Most of these bacteria are quite harmless, and perform useful tasks in the life of nature around us. A few, however, are definitely harmful. These may cause disease. Some of the most deadly diseases, which annually kill millions of people, are spread through impure water. The most

Photo: Underwood.

WELSH WATER FOR BIRMINGHAM.

Lake Rhyader, in Central Wales, which supplies water for Birmingham.

common are typhus, enteric fever, and cholera, which are now very rare in Britain but are still very prevalent in the East.

Although water has always been the main drink of the world, men soon discovered that, compared with other drinks, it was rather tasteless. The result was that, although water supplied the needs of everyday life, almost every country has now its own tastes in drinks, ranging from the tea, coffee, or cocoa of western lands to various fruit or vegetable drinks in the Tropics.

Moreover, in his search for a little variety in his drink, man has discovered how to manufacture quite a number of more or less tasty beverages. Of these, various kinds of beer or spirits are the most widespread, while in certain parts of the earth wine forms the chief drink.

We do not know who first discovered wine, or where it first originated, but it is probable that it was the very first drink to come into general use. The vine was plentiful in the orchard lands where man first found his home upon earth.

The early wines seem only to have been the fresh fruit juice of the grape. The butler who served the wine at the state banquets in Egypt, prepared it by squeezing the grape juice into the wine cup. Such a drink was very pleasant, and not particularly intoxicating. As time went on, however, men began to store wine, and it was soon discovered that this made a great deal of difference to the fruit juice. While the flavour altered somewhat, the drink now had certain after-effects upon the folk who drank it. Some of these effects were pleasant and invigorating, so that merriness and light-heartedness were soon connected with drinking wine. On the other hand, too much of the new drink was harmful, causing drowsiness and heaviness.

To-day wine is the principal drink of the lands bordering the Mediterranean Sea. France is the greatest of the wine-making countries, producing over a thousand million gallons every year. In addition, the French buy another two hundred million gallons above what is sold to other countries. The amount of wine drunk in France averages three-quarters of a pint per day for every man, woman, and child. This huge demand is supplied by over one and a half million vineyards, one-third of which are owned by peasants.

Italy is another great wine-producing country, and Spain comes third. In these lands wine is the only beverage for the majority of the people, who seldom drink water unless it has been boiled. A. K. Madan

In Britain nowadays very few people drink wine except as a luxury or as a medicine. This is partly due to its high cost. At one time in the Middle Ages wine was cheaper than beer, and could be bought for as little as a halfpenny a gallon, but nowadays tea and coffee are the most popular drinks.

Like wine, the making of beer is of great antiquity. It was a popular drink in early Babylon long before the Pharaohs reigned in Egypt, being drunk alike by kings and labourers, by mistresses and maids. Brewing was also important in Egypt, and many records have been preserved of the making of beer in those far-off days.

When the Roman legions fought their way into Central Europe they found that brewing was quite well known, while to-day even the most primitive savages make some kind of beer. The making of beer is therefore one of the oldest and most widespread occupations upon earth.

The material used in the manufacture of beer is some kind of food-corn, with the addition of flavouring. Barley is principally used, but the Japanese use rice, the Chinese use millet, and in South Africa the Kaffirs employ maize, as do

Photo: Guinness Son & Co. Ltd.

AMONG THE HOP VINES IN SUSSEX.

Hops are grown extensively in Kent and Sussex. The creepers grow around a network of strings and wires supported by long lines of tall posts. These men on stilts are working in a hop garden, attending to the plants. Notice the flowers, which will soon be ready for picking. Afterwards they will be dried and sold to brewers to give the colour and flavour to beer.

the Indians of South and Central America. The methods of manufacture vary, but the general idea is the same. The crushed corn is cooked as a kind of thin porridge or mash. This is then allowed to stand until the mixture begins to ferment. During this time alcohol is slowly forming in the liquid. When the process is complete the liquid is poured off and forms " beer."

It is a far cry from these simple methods to the work in a modern brewery, where the buildings may cover many acres. This great development was due largely to the monks in the great monasteries of the Middle Ages. Even the strictest brotherhoods had their own breweries, and during the centuries following the Norman Conquest the general quality of the beer was greatly improved. It was the monks who first hit upon the idea of adding hops to the beer to improve the flavour.

Brewing was not confined to the monasteries, however, and alehouses, the forerunners of the modern "public house" became common. Each of these had its own brewing house, and, in addition, beer was brewed on every farm and in every gentleman's house up till the middle of the nineteenth century. By that time large brewing firms began to buy up the smaller breweries, and to-day the manufacture of beer is in the hands of a small number of very large companies.

The brewing industry is very important to the farmer, and many thousands of acres of barley are grown every year to supply its needs, while large quantities are bought from abroad. Generally speaking, the brewers pay better prices for barley than any other users. The barley is treated in such a way as to change it into a substance called malt, and from this malted barley the beer is brewed. The average amount of beer drunk each year in Britain amounts to about fifteen gallons per head, the consumption being highest in the big industrial districts.

Although this may seem large, it is much less than in the grain-growing districts of Central and Eastern Europe, where beer forms almost the only drink. Side by side with the manufacture of beer, the breweries also manufacture vinegar and yeast.

Another industry of considerable value to the farmer is the manufacture of spirits such as whisky, rum, and brandy. These are made by concentrating the alcohol obtained in brewing. Broadly speaking, whisky is made from grain such as barley or rye, rum from sugar-cane, and brandy from wine. In most countries the manufacture of such liquors is carefully controlled or even prohibited, while heavy taxes are levied upon the manufacturers, both of beer and spirits.

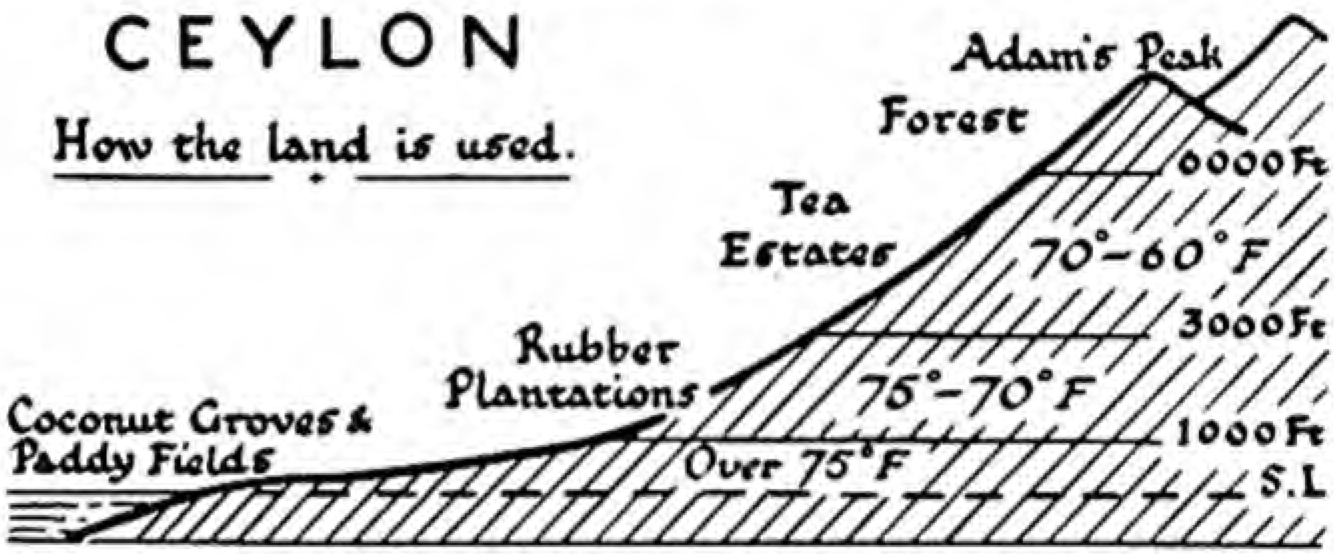
Within the past century a great change has taken place in England, and nowadays tea, cocoa, and coffee are the chief household drinks. These are prepared from the produce of plants which grow only in the tropics, and from which a hot drink can be made to which sugar and milk may be added.

Tea, the most popular of the three, is made from the dried leaves of a tropical shrub which is an important crop in certain parts of monsoon Asia, and has been cultivated since remote times in China. In 1834 it was discovered that the tea plant was growing wild in Assam, in north-east India, and an attempt was made to cultivate it for the market. Since that time the cultivation of the plant has spread not only over Assam, but to Ceylon and South Africa.

The wild tea plant of Assam grows to the height of a fair-sized tree, and its leaves are larger than that of the bush tea plant of China. As cultivated, however, the plant is pruned and cut back, so that it forms a low bush convenient for picking. The young plants, raised from seedlings, are planted out in rich, well-drained soil. Normally a gentle slope is most suitable, and most tea-gardens are on hill-sides which have been carefully terraced. In Ceylon the plantations are at from 3,000 to 6,000 feet above sea-level. In Assam the plantations are quite successful on the

plains, but deep drainage channels are provided and the bushes are grown upon the ridges between the channels.

Plucking begins in the third year, being carried out every seven to ten days. The end bud and two leaves are taken first and then, as the young shoots develop, their leaves are removed. At the end of the season all the leaves are taken. The plucked leaves are at once carried to the



In Ceylon, which is a tropical island, the temperature does not vary much throughout the year, but decreases with height above the sea. This enables different kinds of crops to be cultivated at different levels.

withering house to commence the process of manufacture into the tea which we buy.

Large numbers of workers are needed on a tea estate, and the plucking must be done carefully. Over a million workers, including women, are employed on the Assam tea plantations, working under the direction of white overseers.

The English-speaking countries of the world drink eight times as much tea as all the rest of the world together. Most of the tea used in Britain comes from Ceylon or Assam.

Another important beverage is cocoa. This is made from the seeds found in a fruit which grows like a red cucumber on the trunk of a small tropical tree. The cocoa tree, or cacao, to give it its proper name, was first discovered in South

Photo: Dept. of Agriculture, Trinidad.

OPENING CACAO PODS, TRINIDAD.

The West Indies produce a very fine quality of cocoa. These workers are splitting open the pods and scooping out the white mass of pulp which contains the seeds, or "beans." A basket of pulp can be seen on the left. Behind the workers on the right is a banana plant.

America. It needs a rich porous soil, and was introduced into West Africa by the Portuguese and Spanish, who made small plantations in the islands of Fernando Po and St. Thomas.

Sixty years ago a native of Accra, on the mainland, brought a few cacao pods home with him from Fernando Po. The seeds were planted, and the trees did well. As a result other natives began planting. Large areas of tropical forest land were cleared, and cocoa farms developed rapidly. To-day the Gold Coast produces more cocoa than all the rest of the world together.

The trees, grown from seedlings, are planted about twenty feet apart, and commence to fruit in four years. Small pink flowers appear on the trunk and main branches,

and are followed by large pods the shape of a fat cucumber. These are carefully cut from the tree so that the flower-bud for next year, which is beneath the pod, is not damaged.

The pods, piled in great heaps, are next cut open with a heavy knife, and the seeds, surrounded by a snow-white pulp, are scooped out. The seeds are now spread out on large trays to dry and are allowed partly to ferment. When

TEA

ready, the seeds are packed into bags and sent down to the coast by rail or by motor lorry, to be exported from Accra or Takoradi.

The growth of cocoa farming in the Gold Coast is an interesting example of the fact that black men, without much white assistance, have been able to build up a new industry by their own efforts.

Cocoa is also produced in the West Indies and in Central America.

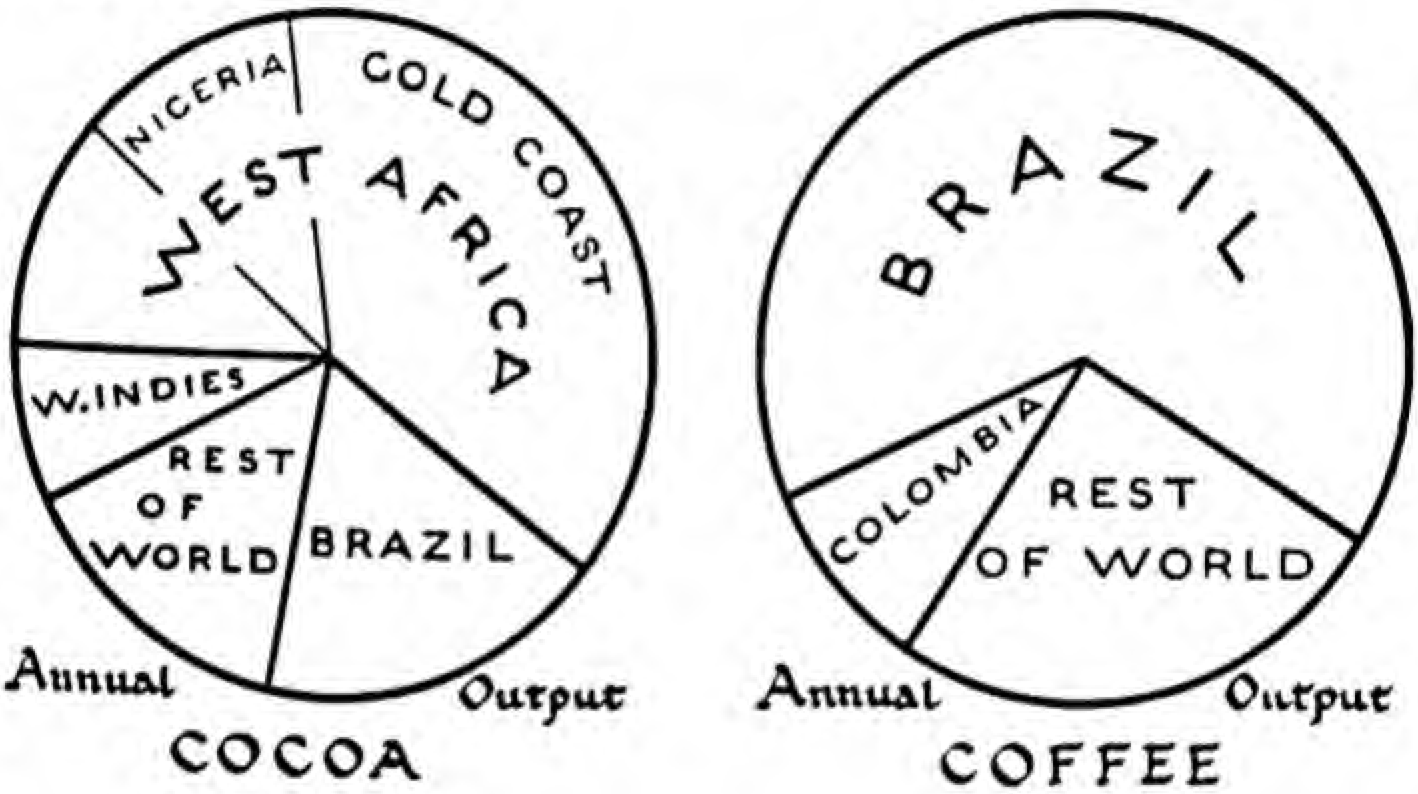
Coffee, the third great household beverage, is not so popular in England as in continental countries. Although the plant, of which there are several varieties, is a native of

Photo: Imperial College of Tropical Agriculture.

IN A COFFEE PLANTATION.

Four-fifths of the world's coffee is grown in the State of São Paulo, in South-east Brazil. The beans are the seeds of a cherry-like fruit which grows on small trees. Owing to heavy over-production, the price obtained for the beans has been very low for many years, and some of the growers are now turning to fruit-farming, producing oranges and grape-fruit.

the Old World, the area of its greatest cultivation at the present day is in the State of São Paulo in south-east Brazil, where more than one-half of the coffee of the world is grown. The rainfall, which is mainly in summer, is not excessive, while the warm dry winters are good for harvesting and drying the crop. The plantations are found up to a height of 2,500 feet, within a belt which is practically safe from frost.



As cultivated in Brazil, the coffee plant grows to a height of 10 to 12 feet, being kept within this size by pruning. The trees begin to yield in their fourth year. Two or even three "flushes" of blossom may appear in one year. The fruit, which has the size and appearance of a deep red cherry, is ripe about seven months after blossoming. Thus flowers and fruit are to be seen on the same tree at any one time.

After picking, the "cherries" are dried on a brick- or stone-paved yard. Here they are spread out in the sun and are continually turned until quite dry. When dry the fruit will keep indefinitely. Within each fruit are two seeds,

each encased in a parchment-like covering. Various processes are necessary before the seeds can be separated from the fruit and from the parchment cases, involving the use of expensive equipment. Large estates pay better than small ones because of this. The coffee is exported mainly from Santos and from Rio de Janeiro.

Another important household drink which is becoming increasingly important nowadays is what is known to British and American children as "pop." This consists of water flavoured with different kinds of syrup, and made fizzy by having carbon-dioxide gas forced into it under pressure.

The manufacture of these "soft drinks" or "mineral waters" is a very big industry. In the U.S.A. over £100,000,000 is spent on soft drinks every year, as American folk use them all the year round. In Britain they are drunk more during the hot weather, and the amount sold depends upon the season, but even British folk are getting into the habit of drinking "pop," and there are large firms with fleets of motor vehicles on the roads which deliver bottles of mineral waters or fruit drinks regularly from house to house.

Mineral waters are made in well-equipped factories, where thousands of bottles are washed, sterilized, filled, and stoppered every hour. Usually a measured quantity of syrup is put into each bottle. The bottles are then filled up with the aerated water and stoppered. The making of the syrups is carried out by firms who do nothing else, as the sugar, fruit juice, and colours have to be of a special kind. The water itself has to be very pure and the gas is forced into it under pressure. The carbon-dioxide gas is supplied in steel cylinders from chemical works. Certain kinds of drinks such as ginger beer are made in a slightly different way.

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Chapter VIII

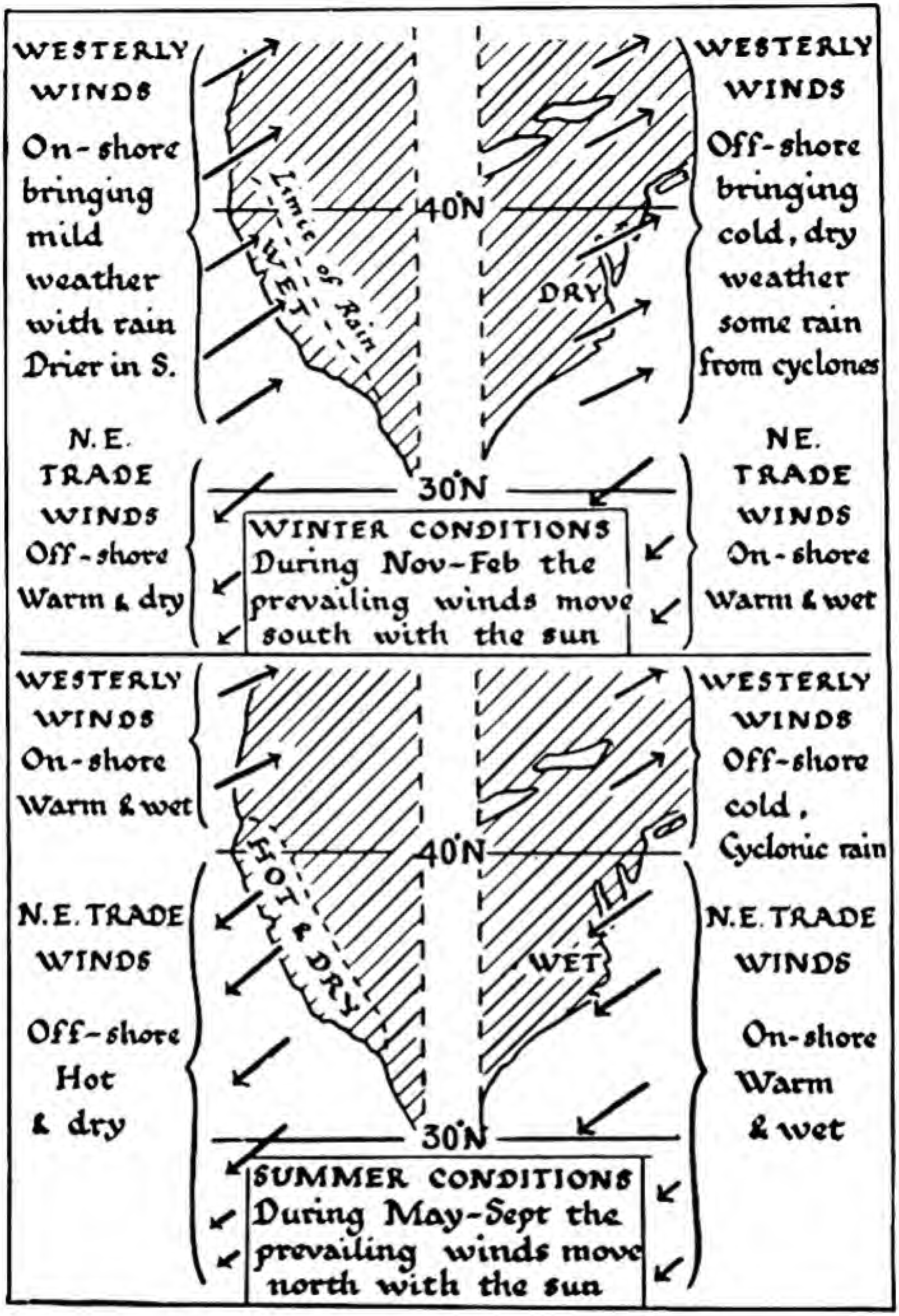
EAT MORE FRUIT

WE have all seen the familiar slogan "Eat More Fruit." The idea, of course, is that by so doing we shall not only be doing good to ourselves, but we shall be giving work to the folk who are engaged in producing or selling the fruit.

The growing of fruit is a very ancient occupation. The two men first mentioned in Biblical history were fruit-growers, and most of the fruits which we enjoy so much to-day have been cultivated upon earth for thousands of years. Practically all of them were found originally in the warm, sunny lands of the Old World on the edge of the Tropics—especially in the countries bordering Mesopotamia, the cradle of the human race.

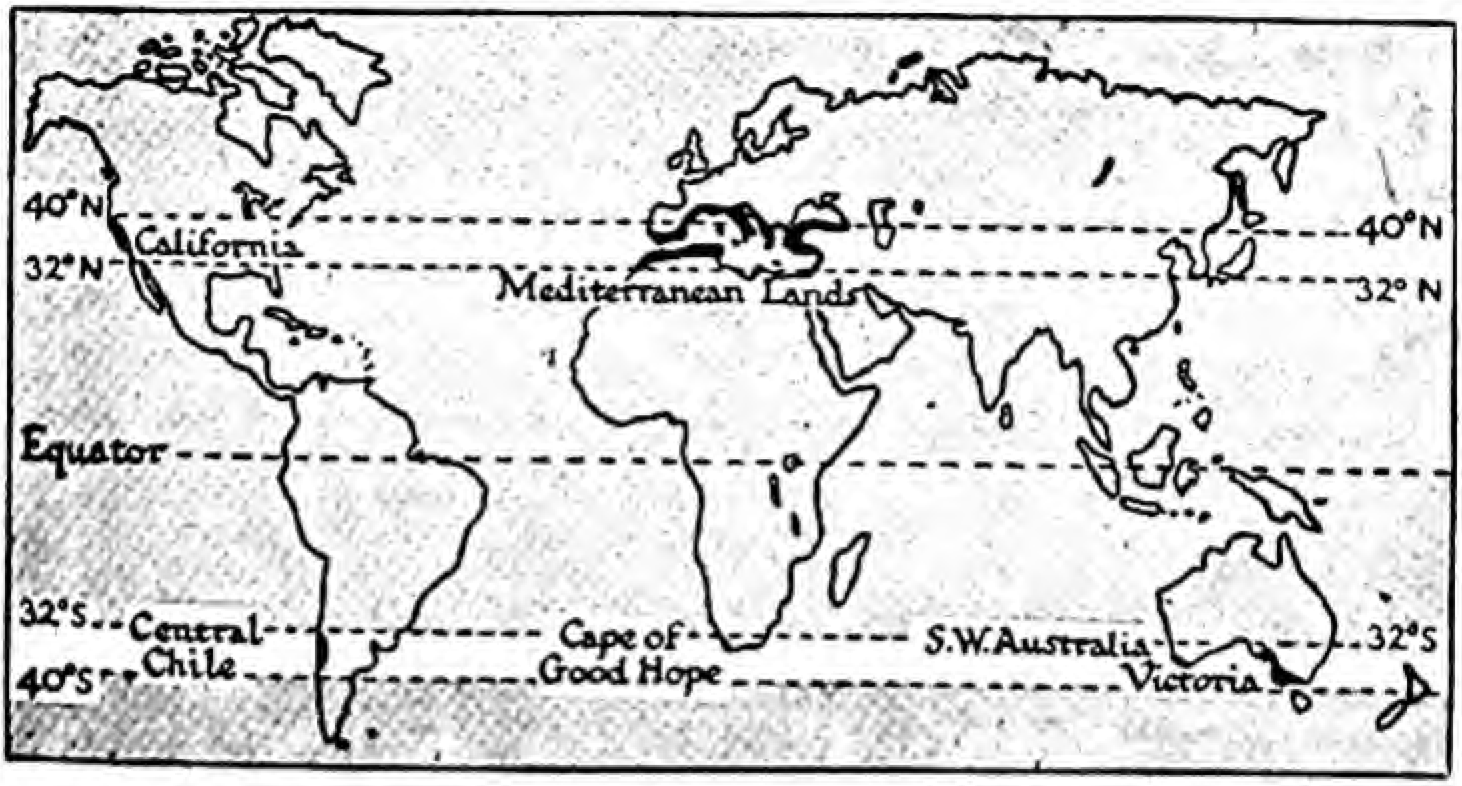
The early fruit-growers were usually gardeners who tended a few trees producing different kinds of fruits, more for their own needs than for sale. Indeed the very tenderness and juicy character of ripe fruit make transport over any distance very difficult. Most of the fruit was grown for eating, but at least two fruits attracted special attention for other reasons.

In those days the three necessities of life, apart from clothing, were corn, wine, and oil. The corn was needed for bread or porridge; the wine was needed for drink in a land where the water was always a doubtful quantity; finally, the oil was needed in the preparation and cooking of



HOW A MEDITERRANEAN TYPE OF CLIMATE IS CAUSED.

Owing to the tilt of the earth's axis, the great wind belts of the world move north and south with the seasons. This brings lands in Mediterranean latitudes into the West Wind belt in winter and into the Trade Wind belt in summer.



MEDITERRANEAN LANDS OF THE WORLD.

Notice that these are found only on the western sides of a continental land mass in the belts of latitude affected by the swing of the wind belts.

food, supplying the fat which is so essential for human existence. Thus we find that the grape and the olive were the very first fruits to receive special attention. Most householders possessed at least one vine and one olive tree, while the more enterprising individuals who had suitable ground to spare, went in for growing as many vines or olive trees as possible, selling or trading the produce to the large number of folk who, being shepherds or herdsmen, were unable to supply their own needs. Thus vineyards and olive groves represent the very first efforts on the part of man to develop fruit-growing on modern lines.

It is to the proprietors of these early vineyards and oliveyards that we owe our ideas of pruning the trees and improving the ground beneath them, while the fruit-growers of California, though they may not realize it when they irrigate their orchards, are only following a practice that was old in the days of Abraham.

THE VINE

The vine and the olive are still the most important of the cultivated fruits in the Near East and in the lands bordering the Mediterranean Sea. Their cultivation, especially that of the vine, has also spread to other corners of the earth where similar sunny weather is enjoyed.

The vine is a climbing plant with fairly deep roots. It needs a warm, sunny situation with a moderate amount of rain, and thrives best in what has come to be known as a Mediterranean type of climate, *i.e.* the kind of climate found in Italy or Palestine—very hot, sunny summers with little or no rain, and mild, damp winters.

Such weather occurs only in a few places upon earth. Its existence is due to the wonderful way in which the earth spins at an angle to the sun's rays. As a result we not only get our seasons, but the great belts of wind which encircle the earth swing northward and southward with the seasons.

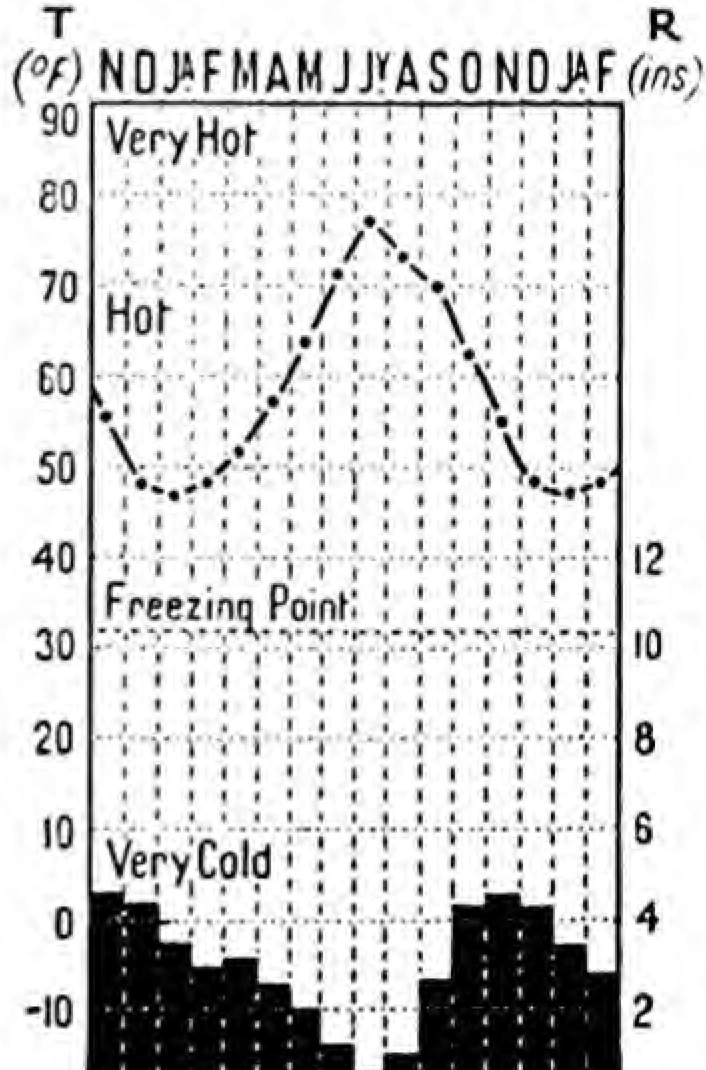
The widest of these belts of wind is that of the Trades, those steady east winds which were such a help to the early traders in their clumsy sailing ships. The Trades encircle the earth in a double belt which extends for about two thousand miles on either side of the Equator. On the outside of this belt, *i.e.* to the north and south of the Trades, is another area of rather stormy winds blowing from the west, so these winds became known as the Brave West Winds, or more simply, the Westerlies. These winds blow in the cool temperate parts of the earth, and wherever they cross the oceans they bring clouds and rain. Britain, in common with the west of Europe, lies within this belt of Westerlies and so it is likely to have rain at any season of the year, especially in the west. On the other hand the Trade Winds blow

towards the Equator, and so become warmer and therefore drier.

If you look at a map of the deserts of the world, you will find that they are almost all within the belt of the Trade Winds.

Now the sunny fruit-growing lands of the world lie just on the edge of the Trade Wind belt, and, as has been remarked, these belts of winds swing north and south with the seasons. The result is that in summer the Mediterranean lands have very dry Trade Winds blowing from the east. This produces a hot cloudless summer with clear blue skies. In winter the winds have moved southward, and then the Westerlies have their turn, sweeping in from the ocean and bringing clouds and rain.

This also happens in California, on the west coast of North America, and in Central Chile, near Valparaiso, on the Pacific coast of South America. Only the tip of South Africa extends into this favoured belt, and so only the corner around Cape Town receives this "winter rain." The same is



CLIMATE OF NAPLES.

This graph shows a typical Mediterranean climate with hot dry summers and mild damp winters. In such a climate pasture is scarce, and plants need special equipment to enable them to survive the long rainless summer. Winter wheat and barley are harvested in April or May. Fruit (especially the vine, olive, and orange) ripens readily. Compare this climate carefully with that of Cape Town (page 101)

TERRACED VINEYARDS ON THE RHINE.
This medieval castle, overlooking the Rhine near Coblenz, is surrounded by vineyards which cover the terraced hillside from foot to summit.

true of the southern coast of Australia from Spencer Gulf to Melbourne.

These are the specially favoured fruit-growing areas of the world, and if you are good at noticing things you will see that each of these fruit lands lies on the west of a large land area, and at about the same distance from the Equator.

The vine is cultivated in all these areas, but France, Italy, and Spain are a long way ahead of other countries in this regard. The fruit is very much affected by the amount of rain. Too much rain means a poor quality of grape, watery and acid, while too little rain results in small fruit, too sweet for wine-making. Hence the finest wine-producing areas are in Western Europe in the countries mentioned, while the grapes of the Eastern Mediterranean (which is farther away from the influence of the west winds)

and the fruit from the dry, south-east coast of Spain, are marketed as dried fruit, such as raisins or sultanas.

This use of the grape owes much of its present importance to a religious influence. The fierce desert warriors who carried the teaching of the prophet Mohammed westward were forbidden to touch wine. The result was that in the vast empire of Islam, which extended over the fruit lands from Spain to the banks of the Indus, wine-making was discouraged. The vineyard owners, however, were not to be beaten, and a large trade in dried grapes developed. This has continued down to the present day. The varieties of fruit now grown in California or Australia for sun-dried raisins were originated by the Moslem teetotallers, who also taught the Europeans (often at the end of a whip) the best methods of irrigation.

In the wine areas the soil determines, to a very large extent, the quality and flavour of the wine. Thus the limestone soils of Burgundy produce a type of wine very different from that produced on the chalk soils of Champagne. The comparatively poor soils of hillsides often yield finer wines than the richer soils of the plains. In Europe the finest wines are invariably produced in hilly districts, especially where the vineyards are on sunny slopes.

In a few districts grapes are grown for the table. Great care is needed both in picking and packing the fruit. The method usually followed is to pack the bunches of grapes in barrels in cork dust. This ensures their arriving at their destination in good condition. Almeria, in Southern Spain, is the centre for table grapes, and South Africa also supplies our home market. In northern countries outside the fruit belt, table grapes are grown in hothouses.

THE OLIVE

The olive ranks with the grape as one of the oldest cultivated fruits. It does not need so much rain and will grow in the poorest soil. It has been grown for thousands of years in the eastern Mediterranean lands, and its cultivation has spread into Italy, Spain, and Southern France, besides being carried to remote lands such as California, Mexico, and Chile. The Spanish conquerors of the New World took the olive with them.

The olive tree grows very slowly, and is never more than twenty to thirty feet in height. The trees are usually raised from cuttings or suckers, and are carefully pruned to preserve the flower-shoots and to keep the trees a convenient shape for picking. The trees thrive best on a poor stony soil, and preferably near the sea.

The ripe fruit is plum-shaped and varies in colour, being usually a very dark brownish-green. The flesh, when crushed, yields a valuable oil, while the unripe fruits are pickled to be eaten as dessert. Jars of pickled olives were discovered among the ruins of Pompeii. Picking is usually carried out by hand, and the ripe fruit is then conveyed to the mill for crushing.

Before the fruit is pressed the kernels are removed. The finest oil is obtained by gently pressing selected fruit. The pulp is then pressed again to yield a cheaper oil, after which it is mixed with hot water and pressed again to obtain poorer oils. Two further qualities may also be extracted.

The three greatest olive oil producing countries are Spain, Italy, and Greece. These supply over five-sixths of the world's oil. Of the Italian oils, the most celebrated is that produced in the tiny sunlit valley of Lucca in Tuscany.

Another fruit which seems to have been cultivated in

Photo: Exclusive News Agency.

PICKING ORANGES IN SPAIN.

The Mediterranean type of climate, with its hot, sunny summers and its mild winters, is ideal for fruit, and such lands as Spain, California, Victoria, and the Cape corner of South Africa are famous for their fruit. These Spanish lads in their quaint smocks are picking oranges in an orchard near Valencia. After it is picked, the fruit is sorted for size and condition, wrapped in tissue paper and packed in long, oblong crates for export.

orchards at a very early date is the pomegranate. Unlike other fruits from the East, this has never become popular in western countries, although a few are to be seen in the fruiterers' shops from time to time. It is a yellowish-brown fruit, the size of a large orange, surrounded by a hard, leathery skin. The inside is packed with small seeds set in a sweet, juicy pulp. It is still one of the most common and popular fruits in the Near East.

CITRUS FRUITS

Yet another fruit which has been cultivated in China and India for thousands of years is the orange. The tree needs a warm sunny climate with plenty of rain. In Spain, where one-third of the oranges of the world are grown, most of the orange groves are irrigated to supply the necessary water to the roots of the trees.

The orange tree is fairly small and seldom bears until the tenth year, but it has a long life and will yield from four hundred to a thousand oranges a year for as much as eighty years. The white blossom appears in the spring, but the fruit does not ripen until the following spring. Thus flowers and fruit may be seen on the trees at the same time.

There are two principal kinds of orange—the sour or Seville orange, grown extensively in Spain, and the sweet or China orange, which is smaller and has a thinner skin. From these many different varieties have been obtained, such as the Jaffa, the Maltese or blood orange, the Californian navel orange, the Tangerine, and the Satsuma, a fine Japanese fruit.

California is now the greatest orange-growing district in the world. This fertile valley, shut in by high, snow-capped sierras, has an ideal climate for fruit-growing. Moreover, the fruit-growers are not even dependent upon the skies for rain, for the melting snows provide all the water needed

in the great fruit orchards. Huge dams hold back the water in the mountains that it may flow through pipes to the places where it is most needed.

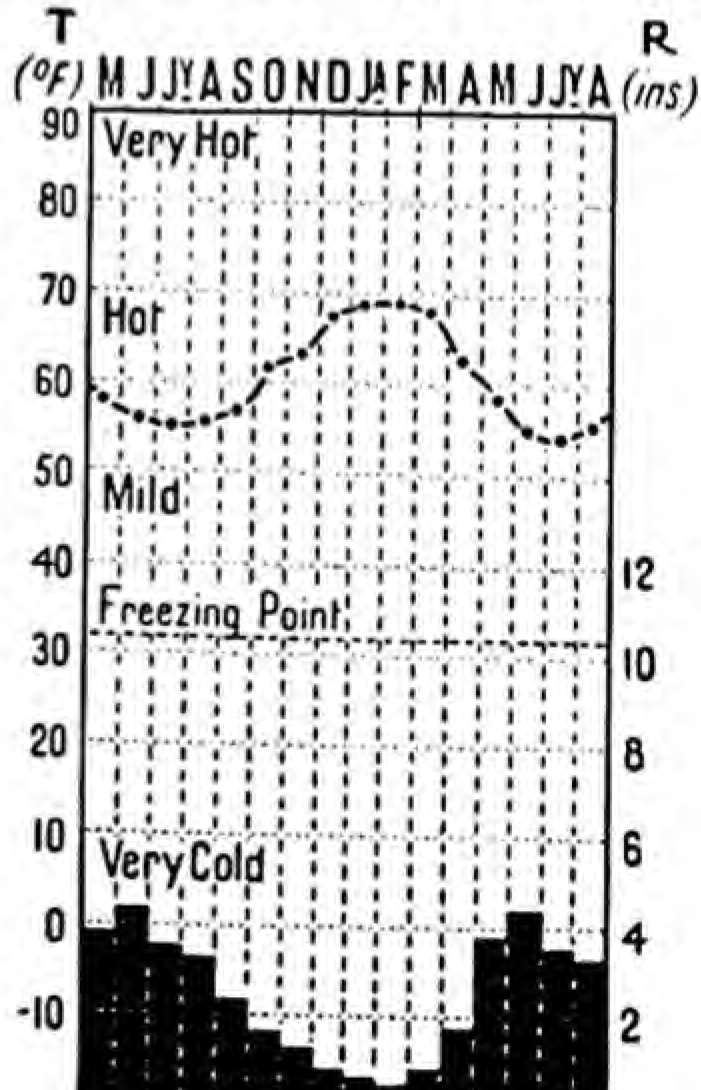
Florida, the land of flowers, where winter never comes, is also celebrated for its oranges.

Most of the oranges seen in the shops in Britain come from Spain—mainly from Andalusia, Valencia, and Murcia. The fruit is picked before it is quite ripe, otherwise it would not stand the journey. It is then carried in large baskets, slung pannier-wise on donkeys, to the big packing sheds.

Here dozens of women and children, sitting upon the ground, sort the oranges and grade them according to size and quality. They are then wrapped in thin pieces of tissue paper bearing the name or brand of the grower. The first oranges begin to arrive in time for the Christmas market.

In Italy oranges are grown on the fertile sunny plain of the Campagna, behind Naples. Japan, Palestine, Australia, and Algeria also produce a fair quantity, and oranges even reach this country from São Paulo, the important coffee state in Brazil.

The orange is only one of a group known as "citrus" fruits. These include the



CLIMATE OF CAPE TOWN.

The Cape corner of South Africa has a Mediterranean type of climate, and is therefore an important fruit-growing region. Notice the marked similarity in the distribution of rainfall at Cape Town and at Naples (see page 95).

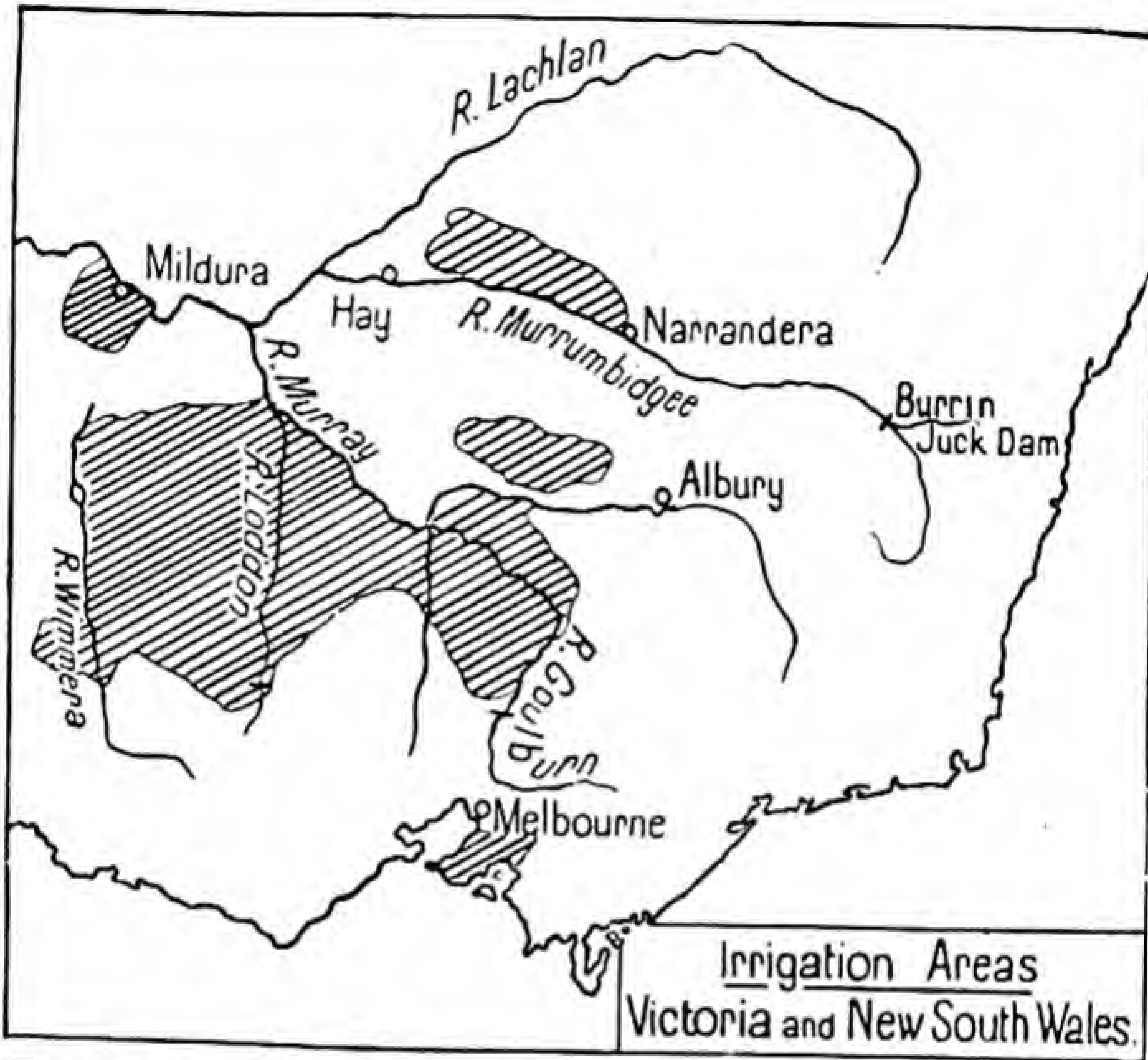
lemon, its cousin the lime, and the grape-fruit. The lemon is a native of India, and seems to have been introduced by the Arabs into Spain at the time of the Crusades. It is now grown largely in Sicily, Italy, and Spain, and also in California. It is a more profitable fruit than the orange to grow, for it will keep longer and is not so easily damaged. The great value of lemons as a preventative of common fevers and illness has been recognized for centuries, especially among sailors. To-day the greatest commercial use of lemons is for the manufacture of citric acid, from which lemonade powders or essences are prepared.

Like the orange, the lemon tree is exceedingly fruitful, as many as three thousand fruits being obtained from a single tree in Sicily. Although picking is possible throughout the year, the main lemon harvest in Sicily is during November and December.

The lime, a tropical cousin of the lemon, is grown mainly in the West Indies, and is used for the preparation of lime-juice and citric acid. Grape-fruit, on the other hand, is grown entirely as a table fruit.

The development of a market for grape-fruit is one of the romances of modern fruit-farming. Until the early years of this century there was practically no demand in Britain for this tropical fruit. To-day, it is being sold in increasing quantities, and the cultivation of grape-fruit is now one of the most profitable occupations in the British West Indies.

The tree, varieties of which grow wild in the West Indian islands, is a cousin of the orange and lemon. It needs a warm sunny climate. Although as a table fruit it has been cultivated commercially for the past thirty years, its production was limited almost entirely to Florida. Then, a few years ago, plantations were made in the West Indies with great



The warm, sunny weather of south-eastern Australia is ideal for fruit-growing. The climate is Mediterranean type, and during the summer water is supplied to the orchards from the Murray River and its tributaries by a network of irrigation channels. The supply of water in the rivers is controlled and ensured by a wonderful system of dams and barrages. Mildura is an important fruit centre.

success. New varieties are being developed and, with careful grading and packing, the West Indian grape-fruit is now firmly established as equal to, if not better than, the best varieties from Florida.

The fruit, which is from four inches to six inches in diameter, grows in bunches. While the rind is yellow and the pulp of the ordinary grape-fruit resembles that of a lemon, the Trinidad planters have specialized in a variety in which the flesh is pink, and the flavour is much superior to that of

the older varieties. West Indian fruits are usually available from December to April, while grape-fruit from South Africa comes in from June to September.

BRITISH FRUITS

The fruits most commonly grown in Britain fall into three main classes: the soft or bush fruits (such as strawberries, raspberries, and currants), the stone fruits (such as cherries, plums, and damsons), and the hard fruits like the apple and pear. Very few of these are native to Britain, and all have been improved by the kinds introduced from Persia and the Near East. They are grown more or less in all parts of the country as garden fruits, but there are special areas where the large growers produce fruit by the ton for the market or for jam-making.

The most important of such areas have a fairly rich soil, and usually a sheltered, sunny position. Kent, which has been well named the "garden of England," produces most of the fruits, but especially cherries and strawberries, for the London markets. Other strawberry areas are Hampshire, behind Southampton, and the Wye Valley. The most important raspberry-growing district in Britain is round Blairgowrie, a few miles from Perth on the southern edge of the Grampians. The fruit is grown for jam, and is pulped by the growers, who boil it with a preservative which makes it possible for the factories to use the fruit months after it has been picked.

Of the orchard fruits, apples are by far the most important, while plums are the main fruit in the Vale of Evesham.

The work of a fruit-grower is not easy. The planting of young fruit trees is carried out during the winter months, from November to February. Great care is taken to spread the roots and to avoid damaging them. From two hundred

Photo: Commonwealth Govt.

A FRUIT FARM NEAR MILDURA, VICTORIA.

Mildura is one of the best-known fruit districts in Victoria. (See map on page 103.)
Notice the buildings for drying and packing the fruit.

to three hundred trees are planted to the acre, ten to fifteen feet apart in regular rows. The ground is carefully worked around each tree to prevent the growth of grasses or weeds. Some fruits, such as cherries, grow best in grass orchards.

From time to time it may be necessary to scrape and clean the bark of older trees to prevent the growth of fungus and to remove diseased bark. This work is also carried out during the winter, and in most orchards the bark is also lime-washed. The majority of fruit trees, and especially apples, are subject to attack by the winter moth which crawls up the trunk. This is prevented by fastening a greaseband round each trunk. The insects are trapped in the grease, and this saves damage to the crop.

Pruning is one of the most important parts of the fruit-farmer's work. If unpruned, the tangled mass of small branches causes the fruit to be stunted and prevents the sunlight from reaching it. Careful pruning keeps the tree vigorous and helps to produce good fruit.

Insect pests are so destructive of fruit that spraying is necessary to kill both insects and their eggs. For spraying during the winter, extracts of tar are now used, but when the blossom or leaf appears, a poison known as Bordeaux Mixture is used. This sticks to the foliage, and prevents attack by caterpillars or leaf-eating insects.

The fruit trees begin to bloom in April, the actual date varying with the season and with the district, there being as much as a month's difference for the same kind of fruit. Cherry blossom appears first, followed in rapid succession by pear, plum, and apple. This is the critical season for the fruit-grower, as frost or bad weather may ruin the prospects of a good crop. It is necessary for the blossom to "set" before the fruit can be formed.

Frost in late spring or early summer may do an enormous

amount of damage. This may be prevented by lighting "smudge" fires on the windward side of the orchard, or by using oil heaters. When alight these warm the air and so counteract the frost. The terrible frost of May 1935 did thousands of pounds' worth of damage within a few hours.

Picking gives employment to thousands of workers for a few weeks. Generally speaking, gipsies do the work the best, for it requires a good deal of care. Cherries are first, in June, followed by plums in July and August, apples in September, and pears later still, some varieties remaining on the trees until November.

The fruit is marketed by big co-operative fruit markets, which are often run by growers themselves. In other instances agents auction the fruit for the growers, the markets being attended by the fruiterers and wholesale buyers. Unfortunately, as fruit will not keep, the prices are very variable. In a good season there may be such a glut of fruit that the low prices do not pay for the picking. On the other hand, a bad season means high prices but very little opportunity to get any benefit from them.

Orchard fruits are grown extensively in Southern Germany and in Central Europe, especially in Czechoslovakia, where the fruit trees line the roads. The great regions which supply orchard fruits for the world's markets are overseas, however.

CANADIAN FRUITS

Canada possesses three important fruit-producing areas. The oldest is in Nova Scotia, the most easterly province on the Atlantic coast, where apples were introduced by the French settlers in the seventeenth century. The fertile valley of Annapolis—not far from the shores of the Bay of Fundy—is the centre of the apple production of this region. As the fruit

is picked it is graded by hand and packed direct into barrels for export. Apples are a hard fruit and will stand this method of packing, and the main apple crop of Eastern Canada is still exported in barrels from Halifax.

The increasing competition of other fruit-growing countries is causing Canadian apple-growers to adopt improved methods of grading and packing. The apples are sorted according to size and colouring, wrapped in tissue paper, and packed in boxes.

British Columbia is another big Canadian apple-growing area, where the sheltered valleys and mild winters are favourable to fruit-growing.

The third and most important fruit area of Canada is between Lakes Erie, Ontario, and Huron, in what is called the Lake Peninsula. Here the later winters and the hot sunny summers favour the production of all kinds of stone and bush fruit, much of which is canned or made into jam. London (Ontario) is the centre of this region.

SOUTH AFRICAN FRUITS.

The Cape Province of South Africa is famous for its orchards, which owed their origin to the influence of Simon van der Stel, one of the Dutch governors in the days when the Cape was a depot for the Dutch East India Company. Since those days fruit-growing has become increasingly important, and with the provision of packing and transport facilities, the fruit exports of South Africa are growing rapidly.

Pears and stone fruits, such as peaches, apricots, or nectarines thrive in this area. Pears thrive best in a warmer climate than that of Britain, and the finest table varieties can be produced in South Africa.

Stone fruits are dried in the sun. Large trays are used and the fruit is carefully watched, being covered at night as a protection against dew. Apricots, raisins, and prunes are the most important of the dried fruits exported.

The Union government has made very strict regulations to control the export of fresh fruit. Each fruit (except grapes) must be separately wrapped and packed in wood wool, in boxes of a fixed size. Every box of fruit must pass the government inspector, and is then branded with the arms of the Union. This has helped the industry immensely.

AUSTRALIAN FRUITS

In Australia the greatest orchard state is Victoria. In the basin of the river Murray, and especially in the Riverina District in the adjoining state of New South Wales, some of the finest fruit in the world is grown. All the fruits grown in Britain and many others, such as apricots and peaches, can be grown. Many of the orchards are irrigated by water provided from the great Murrumbidgee Dam.

TROPICAL FRUITS

Of the tropical fruits, the pineapple and the banana are the most important. The pineapple is one of the best known of the tropical fruits, although difficulties of packing make it almost impossible to secure ripe fruit in good condition in Britain. As a consequence the fruit is usually canned. The pineapples offered for sale in fruiterers' shops are usually small fruits which were cut unripe, and have been artificially ripened.

Contrary to the popular belief, pineapples do not grow on trees, but on the ground. Each plant has a central tap-

Photo: Commonwealth Govt.

A QUEENSLAND SUGAR-CANE PLANTATION.

The north-east of Australia is sufficiently hot and damp for sugar-cane to thrive. Most of the sugar used in the Commonwealth is supplied by the Queensland plantations.

root, and the fruit itself is formed by the berries, which succeed the flowers, growing together into a juicy mass. The similarity in shape to that of a pine cone has resulted in the popular name of pineapple.

The ground is first cleared and ploughed. The young seedlings are planted out in long rows, and the fields are continually hoed to keep down the weeds. In Hawaii and the Philippines long strips of paper are laid down and the young plants are planted through slits. As the pineapple

Photo: Elders & Fyffes Ltd.

BANANA CULTIVATION, WEST INDIES.

The huge bunches of fruit, each containing up to a hundred or more bananas, are being transported by mule from the plantation in the background to a light railway which will carry them down to the port. Fleets of vessels, specially equipped for the purpose, carry the bananas to the Atlantic ports of U.S.A. and to Europe. Bristol is the most important port for this trade in Britain.

grows, the paper strip keeps the plant clear of weeds and in good condition.

When the pines are ripe they are cut from the tap-root and sent to the cannery, where ingenious machines remove the core and scales and cut them up ready for the tins.

The banana has become even more popular than most other fruits. There are many varieties, which grow in profusion in the tropical lands of the Old World, where they are called plantains. Some of these plantains need cooking

before they can be eaten, others are dried and ground up into flour, while others are more like the banana with which we are so familiar.

The banana sold in our shops comes from the West Indies and the northern states of South America. The plant is not a tree but a giant flower with leaves a yard wide and ten feet or more in length. (Incidentally, one of these leaves will provide a young lady of the Pacific Islands with a spring costume!)

The West Indian bananas are grown in large plantations. After the flower has set, the fruit, as a four-foot bunch of bananas growing end-upwards, forms and ripens. Before the fruit is quite ripe the bunches are cut and carried to the cool storerooms provided by the steamer companies. One bunch of ninety or a hundred bananas is a good load for one man.

The bunches are loaded by machinery to specially equipped fruit steamers, which work to and from Bristol, Liverpool, or Glasgow. Care is taken to keep the fruit in cool, dark airy storerooms until it is to be sent to the fruiterers. Ripening is completed within a few hours.

The banana trade has brought prosperity back to the West Indian islands, where the sugar-cane planters suffered severe losses owing to the introduction of beet sugar. The trade is of such importance that several shipping firms run fleets of ships which handle practically nothing else but bananas.

CHAPTER IX

FOOD FROM THE WATERS

ALTHOUGH we are more accustomed to looking to the land to supply us with our food, there is an abundance of life in the waters which cover the earth. Indeed, there is so much more water than land that the resources of the oceans are almost incalculable. There are many thousands of varieties of water creatures, and some of these are large enough and tasty enough to provide man with an almost inexhaustable supply of food.

The abundance of life in the waters seems early to have attracted the attention of our ancestors. They did not know much about the sea; indeed they were rather afraid of it, but the waters in lakes and rivers yielded an abundant supply of food to the peoples living near them.

These early fishers made use of the spear, for nets are a comparatively modern invention. The early spears were little more than sharpened spikes of wood, and as such were not of much use on the slippery scaly armour of the fish. When, however, it was discovered how to tip a spear with a splinter of stone, it became a much more useful weapon. A further improvement was the addition of a barb, which prevented the squirming fish from slipping off the spear.

Barbs, however, are awkward things to make out of stone, and so a new material—bone—came into use, and this is still

Photo: Exclusive News Agency.

AN ESKIMO FISHERMAN.

This Eskimo is fishing for small cod through a hole in the ice. He is standing on a piece of old sacking to prevent his boots being frozen to the ice, for the temperature is thirty degrees below freezing point. Although he does not seem to have done too badly, he would be accounted a poor fisherman by Eskimo standards, for he should have arranged his catch in a circle around him, with their heads pointing towards the hole in the ice, to encourage other fish to come and be caught.

employed by the primitive fishing peoples of the world, such as the Eskimo or the Pacific Islander.

These stone or bone-tipped spears were expensive things to make, for their manufacture took a long time, so if a fisher lost his spear, or if the barbed tip came off, the accident was serious. Hence fishermen got into the habit of fastening the tip of the spear to a leather thong or piece of plaited cord. The other end of the cord was fastened to a wooden float, and so the harpoon came into use.

From the detachable barbed tip on a piece of cord to the fish-hook was a simple progress, and so we get the modern fisherman's equipment. None of these methods of fishing is very rapid. True, an expert spearman can kill an astonishing number of fish when the fish are there to be speared, but a fish is an elusive creature. Other methods therefore were needed if the growing population of the earth was to be supplied with fresh fish.

This resulted in the invention of the net. The first nets were probably made of wicker-work. Such nets are still used among the fisherfolk of Africa and Oceania. Some of the nets were fixed—a kind of basket-work enclosure in shallow water into which the fish could be driven. Others were more like scoops, which could be drawn through the water. Others again were traps into which fish could be enticed by bait, and from which they could not escape.

Who invented the first net we do not know. Like so many of the real benefactors of the human race, he has died unknown and unremembered. The use of knotted grass or cord for fish-catching was a vast improvement. It meant that nets could be made much larger, and they were much easier to handle. Modern nets as used by drifters may be literally miles in length.

Side by side with the invention of nets came the use of

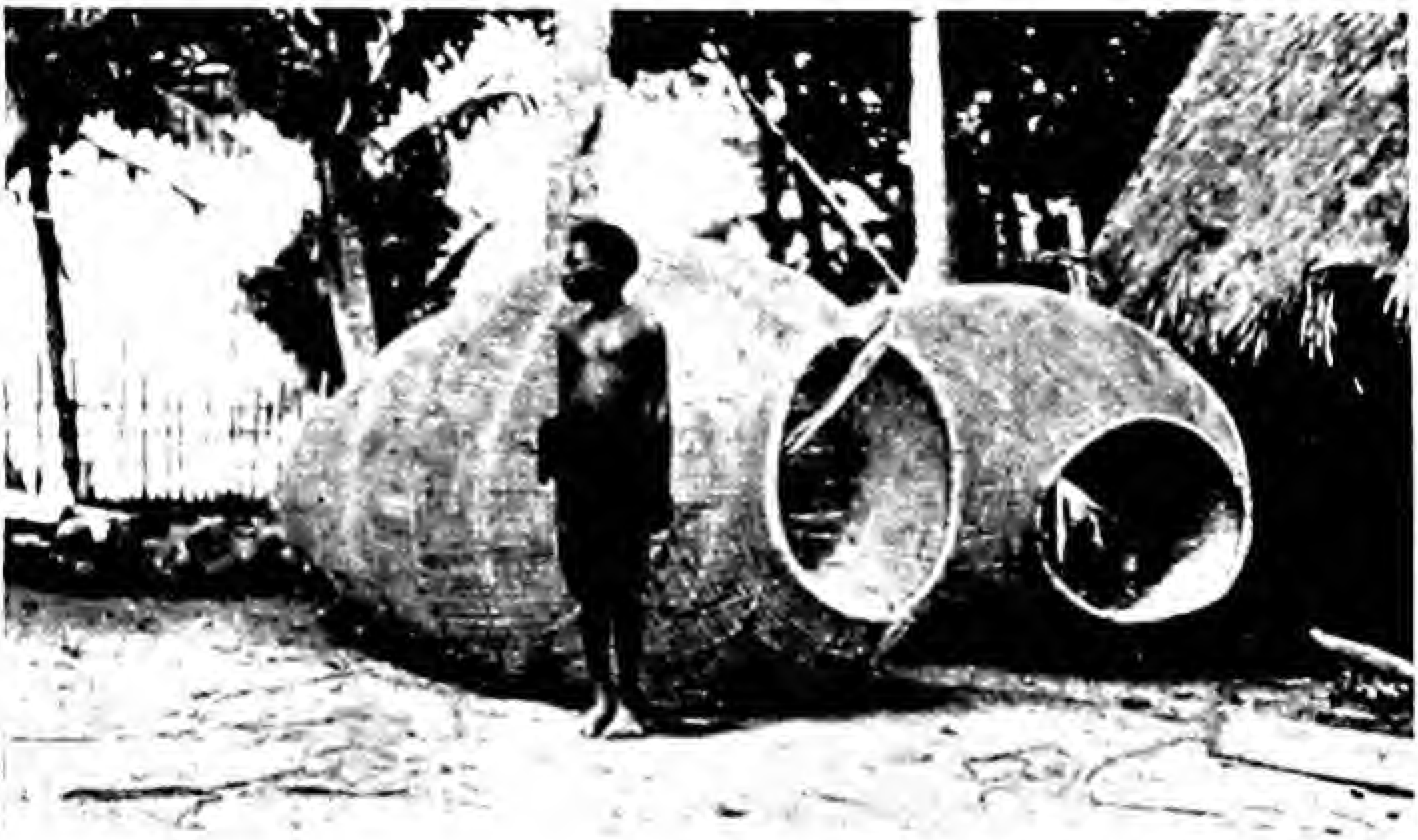


Photo: Exclusive News Agency.

PAPUAN FISH TRAPS.

The fishers of the Pacific islands make great use of wicker fish traps. Those in this photograph are over five feet in diameter, and are woven from rattan.

boats for fishing. Nowadays, with a few exceptions, most of the fish taken by man are caught from boats, and the vast bulk comes from the sea.

The rivers and lakes of the world do yield a very large quantity of fish, but this is important only in the immediate neighbourhood. Most African tribes, for example, practise fishing, while in China—where almost every other person lives in a boat—fish is a very important article of food. With the exception of salmon, however, the vast bulk of the fish supplies of modern countries comes from the shallow seas and tidal estuaries of certain northern countries.

All fish need a certain amount of light, while warmth is necessary to hatch out the young fry from the eggs or spawn. The result is that fish frequent certain parts of the sea in vast numbers. The areas which are specially crowded are where

the sea is shallower than usual. Around the Atlantic and Arctic Oceans the water is fairly shallow because of the existence of what is known as a continental shelf. The land shelves gradually from the coast for several hundred miles before it drops abruptly to the deeper ocean bed. The British Isles is on a continental shelf, as is Newfoundland. The average depth of a continental shelf varies from one hundred to five hundred feet.

The seas above a continental shelf are attractive to fish for several reasons. In the first place there is plenty of food. Fish feed for the most part upon plants, or in turn upon one another. The plants upon which they feed are not like sea-weed which only grows in a shallow fringe around the coast, but are tiny floating plants which exist by the million in the warmer upper layers of the sea. Light and warmth are needed by these microscopic growths, and hence they abound in the shallow waters above a continental shelf.

Then again, the tidal currents are much stronger in shallow water than in the deep oceans. This means that continuous supplies of fresh food are always being brought to the feeding grounds. Finally, as the surface waters are warmer, the young fish hatch out much more readily.

Of the fish which frequent the continental shelves some are surface fish, such as herring, pilchards, mackerel, and sprats; while others, such as plaice, sole, halibut, skate, and turbot, feed near the bottom. Others, such as cod, haddock, hake, and whiting, live in deeper water. On account of these different habits fishermen have to use different methods for each class of fish.

Surface fish are trapped in the meshes of a drift net, which is put out from a sailing smack or from a steam "drifter." The drifters are strongly-built craft capable of making a long ocean journey. They can work at considerable distance from

THE SHALLOW WATERS OF THE NORTH SEA.

The shallow waters around the British Isles are the home of countless millions of fish. The Dogger Bank, which is, in places, only 40 feet below the surface, is an especially rich fishing ground less than 100 miles from the Tyne or Humber ports.

their home port, according to the season, and where the fish are likely to be found. The drifters from the fishing ports along the Moray Firth may be working off the Western Isles during the summer, while in autumn they will be found in the North Sea off Lowestoft or Grimsby.

The principal surface fish is herring, and these are caught

by the million. Vast shoals of herring move about the North Sea, and the drifters endeavour to follow them. Wet or fine, in storm or calm, the fishing fleets must be out and away during the herring season. Each vessel carries a large number of drift nets made of strong cotton, with a one-inch mesh. Each net is from thirty to sixty yards long and fourteen yards deep. During fishing these nets are "shot," so that they hang end to end in one long wall as much as three miles in length. The nets hang about three yards below the surface, and are attached to a heavy manila rope or "warp." The tops of the nets are hung from cork floats, while the bottom lines are weighted, so that the net hangs straight. At intervals the warp is supported by buoys, or by hollow glass balls, each the size of a small football.

One end of the line of nets is attached to the drifter, which is allowed to drift with the wind and tide (hence the name), while the other end of the warp is secured to a buoy. The herrings swimming against the tide, attempt to pass the net and are caught by their gills.

The herring fisheries commence in the Hebrides in early summer, and the fishing fleets follow the fish round the British coast. The main season opens at Yarmouth in October. A great deal of the success of the herring season depends upon the prices realized for the fish. So many thousands of tons are caught that most of the catch has to be cured or preserved. Scots fisher girls split and salt the herrings for barrelling. Since the War of 1914–18 the herring fisheries have lost heavily owing to the fact that a great deal of the catch used to be sold to continental countries, including Russia. These markets are now much less profitable.

Each drifter usually carries a crew of eight, including a cook and an engineer. The running expenses are heavy,

HAULING IN THE TRAWL.

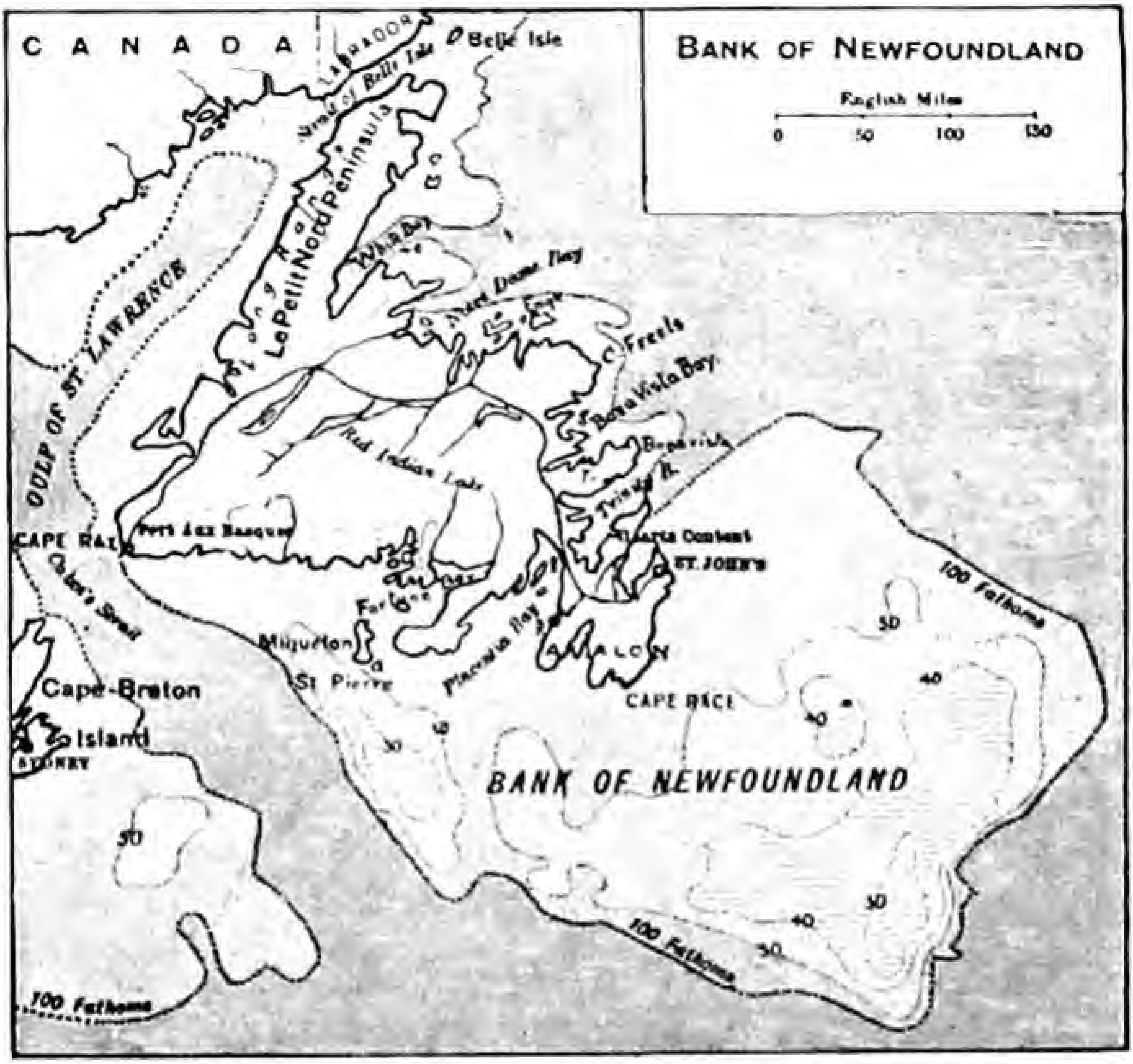
The trawl net and gear weighs many tons, and must therefore be hauled in by machinery. The cod-end, which is the tip of the funnel-shaped trawl net, is just being hoisted up.

being seldom less than £50 per week. About 1,200 drifters are employed in British waters, and the value of fish caught by them averages between £2,000,000 and £3,000,000 per year in normal times.

For bottom fish a different method of fishing is followed. These fish must be caught by trawling. A trawler is a very powerful steam vessel, which tows behind it a large open net, shaped like a conical bag. The meshes of this net are rather larger than those of a drift net, and the mouth, which may be one hundred feet wide and nearly twice as deep, is held open by a strong framework of heavy boards. The lower edge of the mouth of the trawl drags along the sea bed, and is usually towed with the tide for from three to six hours.

As the net is funnel-shaped, most of the fish collect at the narrow end. This is called the "cod-end" and is tied up by a line. When the trawl is hauled in—a task which is performed by powerful steam winches—the cod-end is lifted on to the deck and the end untied to release the fish, which fall on to an enclosed space on the deck. Then the catch is sorted. Although there are lots of good fish in the sea there are also some which are not so good. Different kinds of fish fetch different prices in the market, so the fish have to be sorted. The different kinds of fish are packed in boxes with ice and then the trawler makes for port.

Modern long-distance steam trawlers are now built very much larger. Vessels of over 1,000 tons are common, and these leave British ports for work in Icelandic or Norwegian waters. Some have even visited the North Pacific, while one or two large boats up to 10,000 tons (the size of a liner) now operate off the Norwegian coasts. These huge boats carry a large number of "dories," or stoutly built sailing craft, which fish by line and bring their catch to the parent ship.



THE NEWFOUNDLAND FISHERIES.

The Grand Bank of Newfoundland is a stretch of shallow sea ten times the area of the Dogger Bank, and is one of the richest fishing grounds in the world. The cold waters of the Labrador current bring constant supplies of tiny creatures which are food for the young fish. Notice that the main entrance to the Gulf of St. Lawrence lies through these busy fisheries.

Some of the catch is sent by fast trawlers to British ports, while the remainder is frozen and stored on board. In addition there is machinery on board for the extraction of oil from the livers of the fish and for the turning of the waste or "offal" into fish-meal. Thus each ship is almost a floating factory.

This method of line fishing from dories is also followed on the Grand Bank of Newfoundland, as the fishing grounds there are called. Cod and haddock are the principal fish caught in this way. Long lines of hooks are baited and trailed in the water. A line may be several miles long and carry seven thousand hooks, each hanging from the main line by a shorter line or "snood." The catch may be as varied as in trawling.

Another type of fishing is practised in estuaries and on the shores of bays. A long net similar to a drift net is used. A small boat takes one end of the net out from the shore in a wide sweep and returns to the beach. When the net is drawn in, horses may have to be used, and several tons of fish may be caught.

Of river fish by far the most important is the salmon, which is caught in vast numbers in the rivers flowing into the North Pacific Ocean. The fish, which is a different kind of salmon from that found in British waters, begins its life in the upper streams of the rivers. After two years the young salmon swim down the rivers to the sea, where they spend two or three years until they are full grown. They then return to the rivers to spawn. Millions of fish enter the rivers every season, and it is while they are making their way up the rivers that they are caught.

The most famous salmon rivers of the American coast are the Columbia, the Fraser, and the Skeena. On the opposite side of the Pacific there are also very busy salmon fisheries in the Kamchatka Peninsula and in the island of Sakhalin. Most of the salmon fisheries are controlled by the Japanese.

As soon as the fish are caught they are taken to the nearest cannery. Here they are "topped and tailed" and cleaned by machinery and sliced up into convenient pieces for canning. Although the vast bulk of the salmon catch is

marketed in tins, it has been discovered that a method of chilling, similar to that used for Argentine beef, is very successful. As a result an increasing quantity of fresh fish is now reaching the cities.

Because fish decay so quickly, it is necessary for a very large quantity of the fish arriving at the ports to be preserved in some way or other. Herring may be packed in brine, in which case they are called salt herring. If smoked, they are known as red herring, while if slit open and smoked they become kippers or bloaters. Haddock are usually split open and smoked. Cod may be dried or salted, while the liver yields a valuable oil. Small Norwegian herring, brisling, and sprats, like the pilchards from France or Portugal, are frequently canned with olive oil.

Another class of water creature which is consumed in large quantities is shellfish, such as crabs, lobsters and crayfish, oysters, mussels, and the smaller shellfish such as whelks. Oysters are highly valued as a delicacy, and so they are specially cultivated in large beds in the Thames estuary near Whitstable and Colchester. The Atlantic coast of the United States, washed by the warm waters of the Gulf Stream, produces a great quantity of shellfish.

Many other kinds of fish are caught in the rivers and seas of the world. The tunny, a giant cousin of the mackerel, is caught in the western Mediterranean off Sardinia and Sicily. The Japanese catch a similar fish called the bonito.

The anchovy, a cousin of the herring, is abundant in the Mediterranean. It also visits the Zuyder Zee in large numbers, for there the shallow water is much warmer than elsewhere in the ocean, and the eggs can hatch out. The anchovy fisheries of Holland are very valuable.

The sturgeon is a large fish which, like the salmon, spends part of its life in the sea and ascends the rivers for spawning.

It is most common in the rivers of Southern Russia and especially in the Volga. Another variety is also caught in large numbers in the lakes of North America. The principal object of catching the sturgeon is to secure the roe, from which a table delicacy known as caviare is prepared. Like salmon, the fish are very numerous in the rivers, as many as 10,000 fish being caught at one point in the fortnight during which the sturgeon travel upstream.

Chapter X

THE BAKER AND CANDLESTICK MAKER

ALTHOUGH the earth yields an abundant supply of all kinds of food for the use of mankind, the greater part of that food needs a certain amount of preparation. Until comparatively recent times the vast bulk of such preparation was carried out at home. The housewife of a generation ago was expected to know, not only how to cook a joint or to make cakes and puddings, but how to carry out such tasks as baking bread, plucking and trussing poultry, salting bacon or ham, making fruit wines, pickling vegetables, bottling fruit, and making jam. A glance at an old copy of *Mrs. Beeton* will reveal what an extraordinary number of things in relation to food had to be done at home. Nowadays the modern housewife can get along very well with the aid of a kettle, a saucepan, and a tin-opener.

This remarkable change in the everyday lives of ordinary folk is due to several causes. In the first place we now know a great deal more about why food decomposes, and how to keep it fresh. Then, too, there has been a vast improvement in methods of cooking, and gas or electricity is in general use. Perhaps the great cause, however, is that nowadays most folk go out to work in shops, offices, or factories; spare time is spent out in the open air or at places of amusement, and the home has become merely a place for sleeping. The modern housewife prefers to save time and labour by

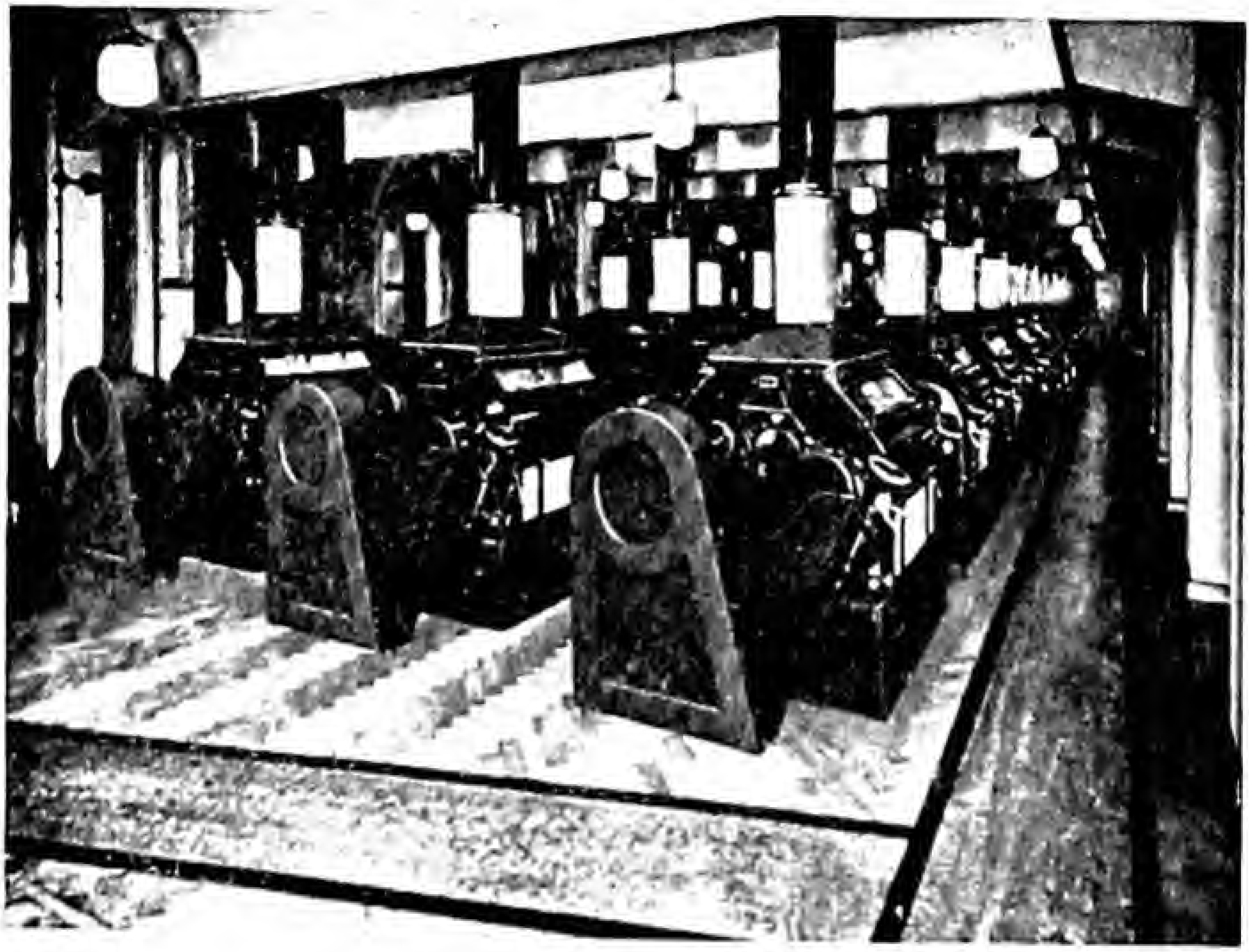


Photo: Thos. Robinson & Son Ltd.

INSIDE A MODERN FLOUR MILL, HELSINKI.

The modern flour mill is a marvel of engineering ingenuity. This shows the "roller floor" in a big mill in Helsinki, the capital of Finland. The wheat, which has been cleaned and partially milled on the floors above, comes down inside those polished columns, which are really chutes, to the steel rolling-mills, where it is ground into flour. This then passes to the floors below, where more machines finish it off. How many machines can be counted on this one floor?

purchasing as much food as possible prepared ready for the table.

With this great change there have sprung up all over Britain, and many other countries, huge works where millions of people are engaged in preparing food, as well as a host of smaller firms and chains of shops where food is sold.

The oldest food industry is the preparation of bread. The miller and baker have pursued their callings for

thousands of years. Every village or town had its flour mill —usually driven by water or wind. To these the farmer or cottager brought his grain to be ground into flour. The miller was paid by being allowed to keep a portion of the flour for himself. The words of the old game, " As the wheel went round he made his grab," refer to this. In some countries such as Italy or Spain the miller still retains one sack of flour out of so many as payment for his work.

Very few wind-mills or water-mills remain to-day, except as curiosities. Those that are worked supply only a very small amount of the flour that is needed. Instead, most grain is ground in large up-to-date flour mills, where the power is supplied by steam or electricity. All kinds of complicated machinery are used, and the milling firms usually buy the wheat or other grain and sell the flour to the bakers or grocers.

Some of the milling firms make special kinds of flour, which are sold under their brand and from which well-known kinds of bread are made. Such bread as Hovis, Daren, Vit-be, or Dr. Allinson's is made from the special flour supplied by such millers. Other firms make branded flour for home cooking, including " self-raising " flour, which has a small proportion of baking-powder mixed with it.

As well as supplying flour for bread or cooking, the millers also grind up food for animals, and all kinds of materials, including beans, peas, and many varieties of seeds are used.

The largest use of flour is for baking. Every year the bakers of Britain make more than one million miles of loaves, in addition to countless millions of cakes and pastries. A large proportion of this vast output is produced by the ordinary bakers in the villages and towns.

Even the baker with a small business uses machinery

Photo: Peek Frean & Co. Ltd.

A MODERN BAKERY.

The manufacture and production of food is one of the big industries of an up-to-date country, and employs hundreds of thousands of workers. This is a view inside a biscuit factory, with its long lines of special machinery.

nowadays. The dough is mixed and kneaded by machines, while the ovens are usually heated by steam, gas, or electricity. The modern bakery has become a small factory.

Of course there are still many places in the world where the old-fashioned methods are still used. In southern Italy the loaves are still baked in the village oven, a bee-hive shaped structure of brick, heated by wood or charcoal. In the large cities of the Western World, however, the business of baking has become so important that the work is now done in huge machine bakeries which turn out loaves by the tens of thousands.

In such a bakery the bread is untouched by hand from start to finish. The flour passes from large storage bins to a machine, where it is automatically sifted, blended, and weighed. The batch of flour then empties into a kneading-machine where it is mixed with pure water at just the right temperature, together with weighed amounts of yeast, salt, and often condensed or dried milk. Powerful steel arms knead the dough thoroughly.

The dough is then wheeled away in steel troughs to a warm room to " rise." After this (which may take several hours), the dough passes into a machine which automatically cuts it up into pieces of the right size or weight. The pieces of dough pass along a travelling band which takes them through another machine, where each piece is gently shaped and dropped into a tin.

The tins then travel slowly through a " prover," where the bread finishes rising. As the tins come from the prover they enter the oven through which they travel slowly, so that when they emerge the loaves are properly baked. After this the hot loaves move through a cooler, and when cool they pass along a travelling band to a wrapping machine, which automatically wraps each loaf in thin grease-proof paper.

The whole of the machinery is so arranged that, from the time that the piece of dough leaves the divider until the finished loaf comes from the wrapping machine, it is travelling all the time. In a large bakery each oven delivers 3,000 loaves an hour while the machinery is working. Fleets of fast motor vans then distribute the loaves to the shops, restaurants, and hotels.

The making of cakes and pastries is quite a trade of its own. Many bakers do not make cakes or pastries, but buy them from large machine bakeries where biscuits, cakes,

tarts, and all kinds of fancy pastries are made. These are packed in boxes and delivered regularly all over the country.

Such biscuit or cake works not only buy large amounts of flour, salt, sugar, and milk, but also huge quantities of other materials such as eggs, dried fruits, and jam. The eggs used in cake-making come largely from China, which is the most important egg-producing country in the world. The eggs are shelled, mixed with a preservative, and exported in barrels or tins. Other eggs are frozen, while dried eggs are also used in the bakery trade.

Owing to improved methods of transport it is now possible for fresh eggs from Australia and South Africa to reach Britain in good condition. The largest fresh egg supplying countries are Denmark and Ireland.

Another branch of the food trade is concerned with the curing of bacon or ham and the manufacture of potted meats. Large bacon factories now do this work, which at one time was done by the farmer or butcher. The principal supplies of bacon come to Britain from the great dairy countries like Denmark and Ireland. The Dominions also send us a small quantity.

Shortly before the Second World War the Government tried to help the farmer by limiting the amount of imported foreign bacon to a fixed annual amount, called a quota. The British bacon factories were expected to make up the rest of the bacon that was needed. They did this by buying pigs from the farmer on a contract system which was controlled by the Bacon Development Board.

The farmer contracted to supply to the factory so many pigs of a certain quality and weight during a month. The factory agreed to pay a fixed price, and so the pig farmer knew just what his pigs would fetch. If, however, his pigs

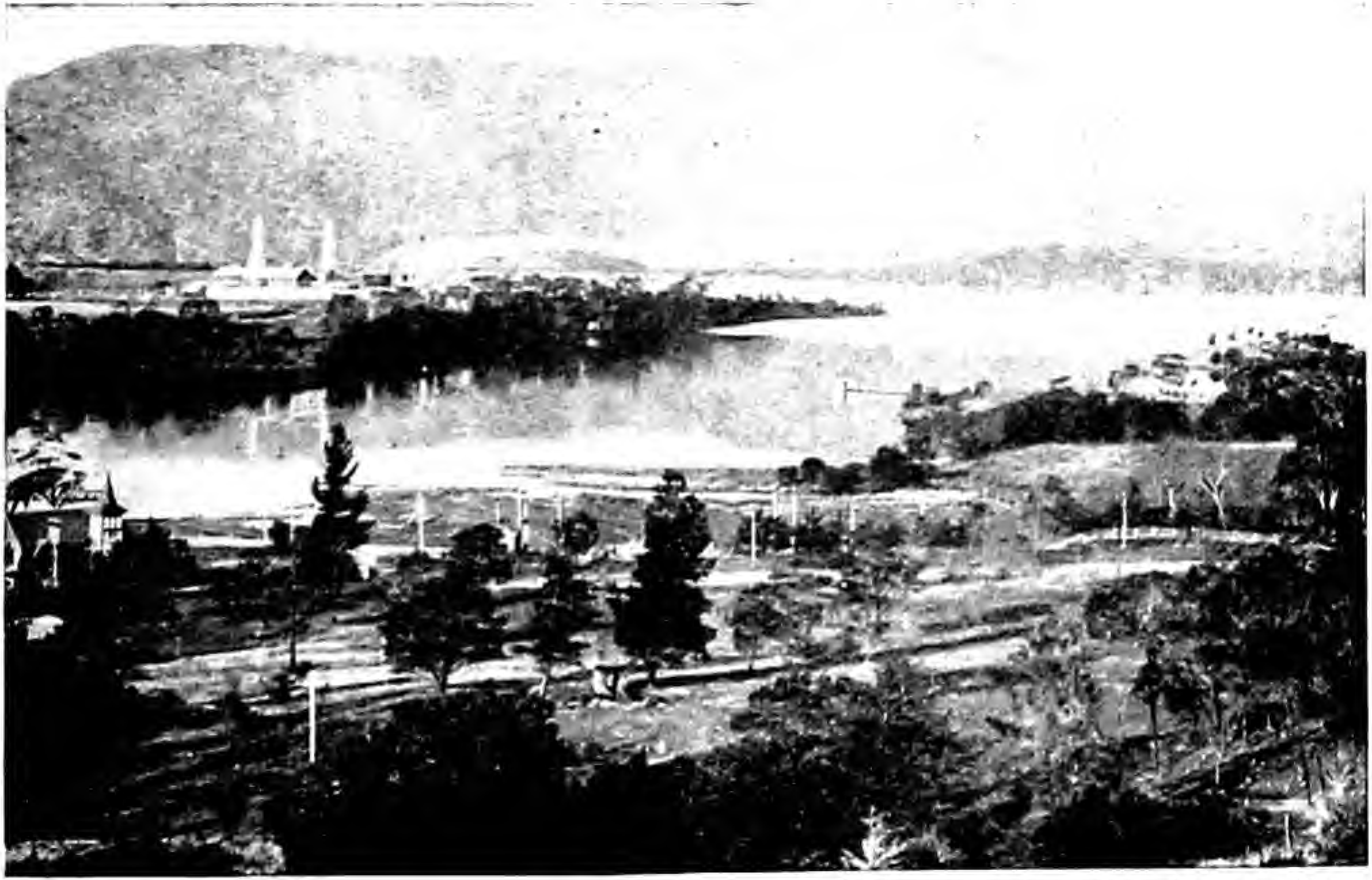


Photo: Commonwealth Govt.

CADBURY'S CONFECTIONERY WORKS, CLAREMONT, TASMANIA.

The works are in the middle distance on the left.

were not up to size or weight, or if he did not deliver the agreed number, the farmer had to pay a penalty.

On the whole the scheme worked fairly well, and if the farmer did not wish to sell his pigs to a factory, he could sell them in the ordinary market. During the war, however, this system had to be revised, and farmers must now sell pigs to the Ministry of Agriculture at fixed prices.

The factories also manufacture preserved cooked meats of various kinds. Sausages are another important manufactured food. They contain either pork or butcher's meat mixed with special meal.

This side of the industry has increased enormously during recent times, as it is now possible without difficulty to keep food fresh for several weeks.

This question of keeping food fresh is not quite as simple as it may seem. Very few substances "go bad," or decompose, of their own accord. In almost every case decomposition is caused by the operations of tiny microscopic living creatures which may be called microbes. Fruit or vegetables may also be destroyed by the operation of what is called an enzyme, a substance which causes them to "ferment."

Now it so happens that the processes by which food is decomposed are the same processes by which food is digested when we eat it. The saliva in our mouths, for example, contains an enzyme, which helps later on to change the food into body-building materials. If food were treated in such a way that neither microbes nor enzymes could affect it, neither should we be able to digest it.

This makes the preservation of food a very tricky matter. Generally speaking, chemicals which might prevent the decomposition of the food will also have harmful affects upon the people who eat such food. For this reason the

addition of chemicals is prohibited nowadays by the pure food laws of most countries.

One method of preserving food is to kill all the microbes present in it by exposing it to heat, and at the same time to seal it up inside a can so that no other microbes can get at it. This is the method used in canning fish and other meat foods. It is fairly successful, but such food must be eaten soon after the can is opened.

The heating process has to go on long enough not only to kill the microbes, but also their eggs or "spores." The spores of some of these microbes are very "tough," and need to be cooked for half an hour or more at a temperature a good deal higher than that of boiling water, before they finally die. As a matter of fact it is very seldom that all the microbes are killed. What really happens is that most of them are killed, while the others cannot attack the food because it has been changed by the cooking. Cooked meat will always keep longer than fresh meat.

Canning has been so successful that it has become one of the world's most important industries. The meat industry of the United States has been developed with the aid of canning. The fishermen of Norway and of British Columbia depend largely upon it, and the fruit-growers in remote parts of the earth such as Australia or California owe their prosperity to it.

The great discovery, however, which has helped in the preservation of food is that of the use of cold, or refrigeration. This must rank with the great epoch-making discoveries of the world, such as fire or the use of iron. The preservation of food by keeping it cool enables vast quantities of meat and other foods, produced under ideal conditions in one part of the world, to be transported without deterioration to feed the crowded factory workers or city dwellers in other lands.

The fact which makes this possible is that while the cold does not destroy microbes, or "bacteria" as we should call them, it prevents them from growing or from affecting the substances with which they are in contact. In other words, they go to sleep, if such a thing were possible. Even enzymes cannot work at low temperatures. As a result, if the temperature of food is reduced to freezing point it will not decompose in the ordinary way, but will keep fresh for a long while.

Many foods which are "chilled" may be kept in that condition for months and yet be quite as good at the end as they were at the beginning. Some foods, however, change during the cooling, so that they are not quite the same after they have been chilled or frozen. A good deal depends upon how the cooling is done. Some foods need to be cooled rapidly, others more slowly; some are frozen, others are only chilled.

The foods most usually preserved by freezing are meat, fish, poultry, and butter. Eggs, vegetables, and fruit are only chilled, *i.e.* the temperature is just above freezing point.

Not only is cold storage of great assistance in the food trade, but ships, railway vans, motor lorries, and even aeroplanes are fitted with refrigerators, so that the food is kept in good condition while it is travelling. The dealers in the great food markets usually have their own cold storage rooms. Nowadays it is possible for a shipping company to ring up a poultry dealer on the phone and order several thousand birds to be delivered to a particular liner, and the order will be completed the same day.

The ordinary shopkeepers and butchers, even in small villages, have their refrigerators so that meat or perishable foodstuffs can be kept in good condition. The small

household refrigerator is now coming into general use in Britain, enabling the housewife to keep food fresh and good. In the United States and in Canada, where the

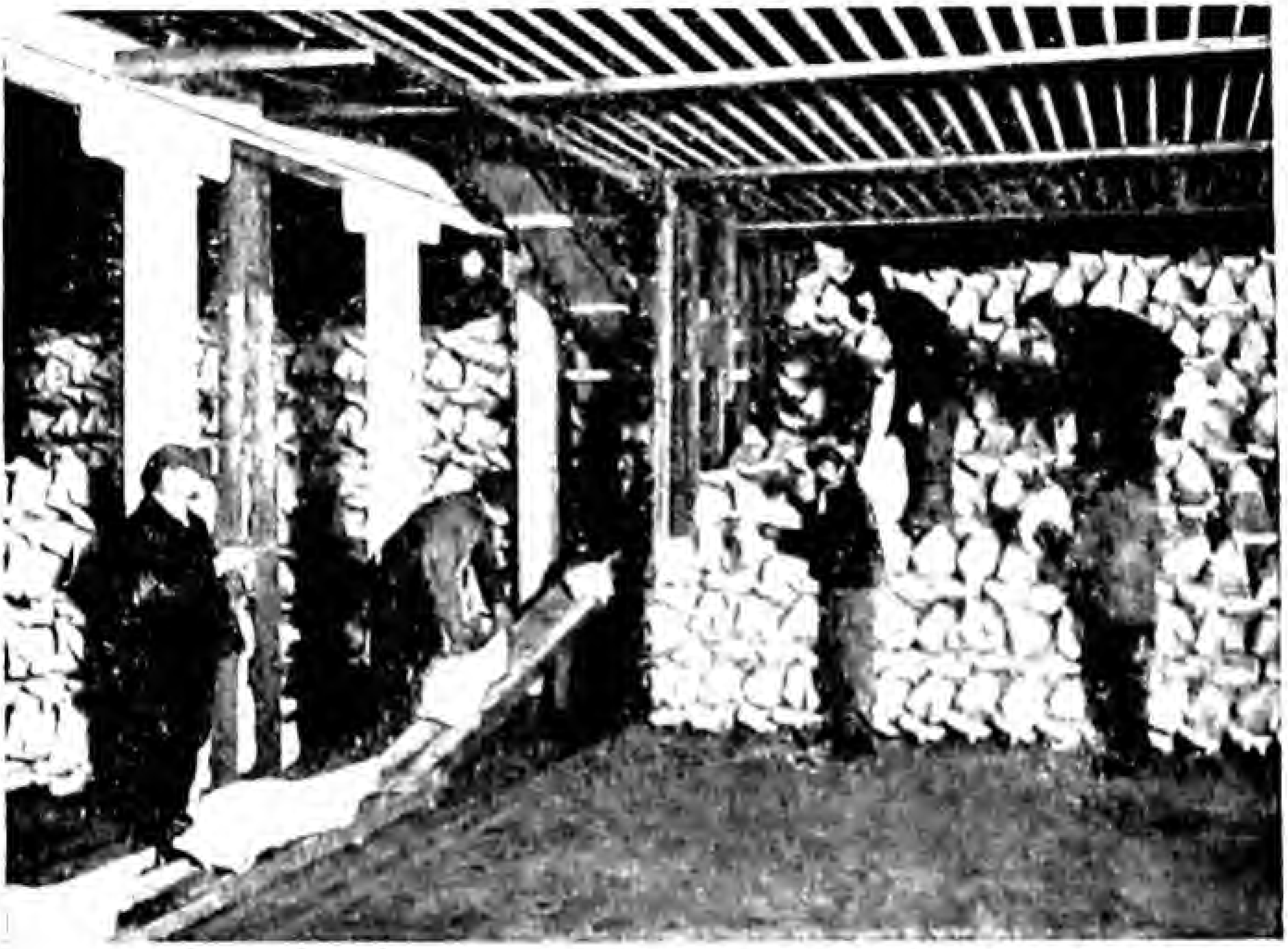


Photo: New Zealand High Commissioner.

NEW ZEALAND LAMB IN COLD STORAGE.

A scene inside one of the many cold storage depots where, under Government supervision, thousands of carcasses of mutton or lamb can be kept fresh and in good condition for long periods. These men are working in a temperature many degrees below freezing point. Notice that each carcass is sewn up in mutton cloth.

summers are much hotter than in Britain, the ice-box or refrigerator is found in every home.

There are many other methods of preserving food, some of which have been in use for centuries. Certain foods such as seeds and nuts will keep indefinitely if dry. Grain stored in the tombs of the Egyptian kings has been found quite good

after thousands of years. The reason for this is that bacteria cannot grow on dry materials. If, therefore, food substances are dried they will keep quite a long while.

This method of preservation is employed in drying fruit. Raisins, plums, peaches, apricots, and other fruits are dried by spreading them out on wooden trays in the sun. This method is practised in Australia, South Africa, and California as well as in Mediterranean lands.

Meat used to be dried in this way, but nowadays the method is only applied to meat extract. Such well-known extracts as Oxo, Bovril, and Liebig's owe their keeping properties mainly to the fact that most of the water has been evaporated.

Sugar is another well-known preservative, especially if the food contains acid. Hence jams and preserves will keep fairly well if they are kept covered. The mould which may form on the surface of jam is caused by microbes from the air, and occurs because the air has not been excluded. On the other hand, too much sugar may cause the jam to ferment.

Salt is one of the oldest preservatives known to man, but actually it is not a very good one. Salted goods will only keep if they are dry. Hence salt is useful mainly with dried or smoked meat such as bacon or ham. Smoking is another method of preservation, although used only for fish or ham.

Pickling in vinegar also preserves vegetables, fruit, or fish. In this method success depends upon cooking the food to destroy as many bacteria as possible. The vinegar prevents any fresh germs developing. Pickles must, however, be kept away from the air as much as possible, and the length of time that they will keep depends upon the vinegar keeping its strength. After a few months the vinegar loses its power and the pickles will no longer keep.

The manufacture of pickles and sauces is, however, not so much to preserve the food they contain, as to provide tasty preparations to eat with other foods.

Among the other manufactured foods, which give work to many thousands of people, may be mentioned the preparation of cocoa and chocolate, the refining of sugar, and the manufacture of all kinds of confectionery. To these must be added the great dairy factories where butter, cheese, and various kinds of dried or condensed milks are made. Another important manufactured food is margarine.

To supply all these factories, bakeries, and storage plants with machinery and equipment gives employment to tens of thousands of workers in the engineering industries. Other firms are engaged in making cases, cans, bottles, packets, and labels, while millions of people are engaged in the sale of the foodstuffs.

The preparation and sale of food now employs more people than any other occupation in Britain. Side by side with this, there are now thousands of restaurants and feeding-houses where people may obtain a meal ready cooked and served. In the United States 60,000,000 meals are served daily in public restaurants. In Britain the number is about 12,000,000, and is increasing steadily.

In some countries this habit of feeding away from home has grown so much that there is no real home life. In many large cities people live in blocks of flats and eat their meals in communal dining-rooms. We are becoming more like the ant in our habits, if not in industry.

CHAPTER XI

WHAT WE WEAR

FOR many centuries wool was the only material from which clothes could be made. This naturally had its drawbacks, particularly in warmer lands, and this compulsory "flannel next to the skin" led to much searching after substitutes.

LINEN

The discovery of a new clothing material seems to have been made in Egypt, the home of so many bright inventions, such as writing and geometry. This material was flax, prepared from the stringy leaves of a water-loving plant that grew beside the Nile.

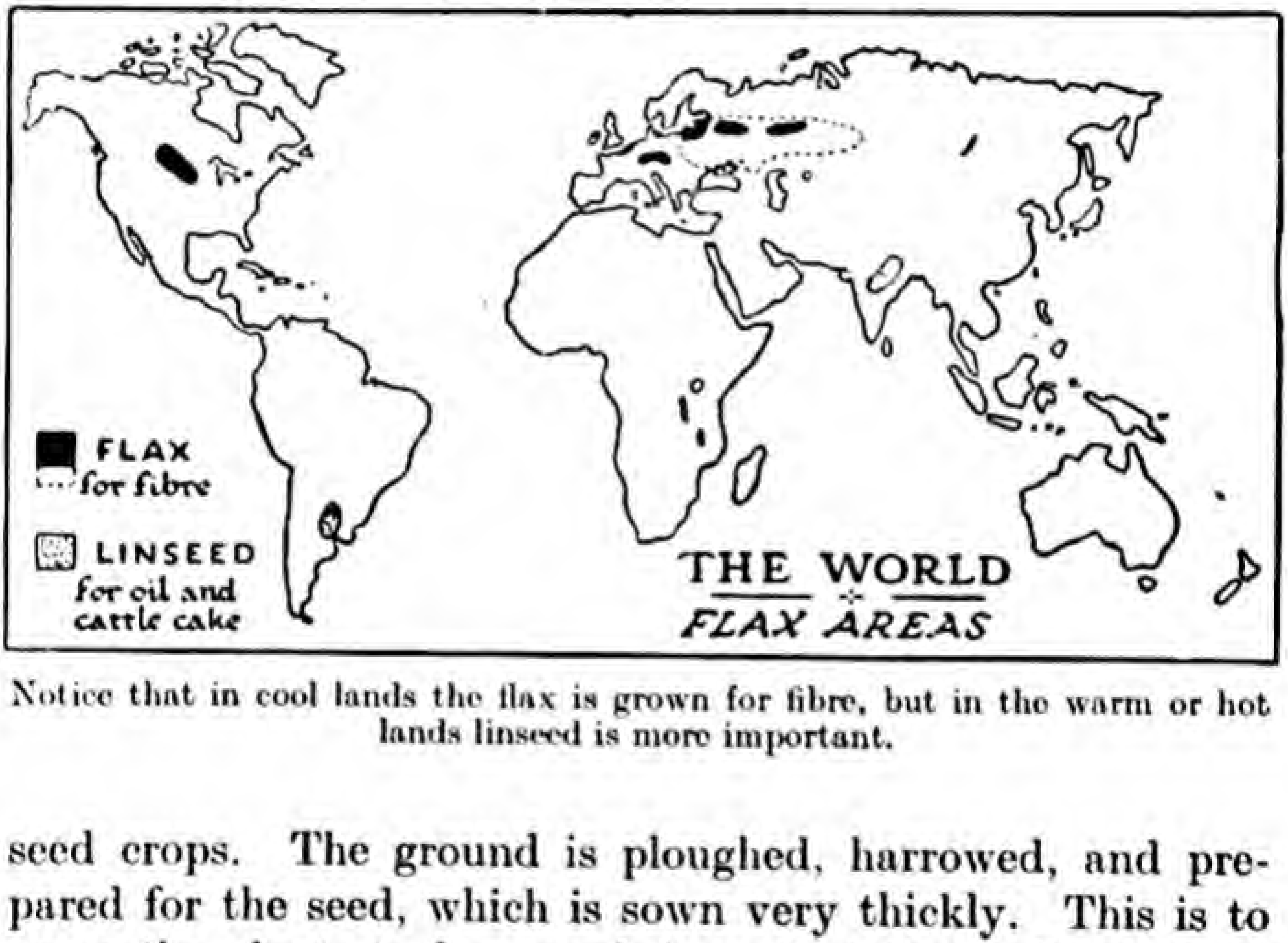
From this the first linen was made.

The new material was cooler, more comfortable, and wore well, and so the Greeks, ever an enterprising people, carried it into Europe. The use of linen also spread among the peoples of Western Asia, and the new plant rapidly became one of the more important of the farmers' crops.

Flax was not unknown to the less civilized people of the Stone Age in Northern Europe. They, however, seem to have used it only for twisting into lines and cords used for fishing and hunting. The wild flax which they used in this way was little better than a coarse grass, much inferior to the cultivated flax of Egypt.

Flax to-day is one of the important crops of the world. It is grown in large quantities in Russia and the damper parts of Northern Europe. It is also cultivated for its seeds (linseed) in India and Argentina. The finest flax is grown on the borders of France and Belgium. It is also a main crop in Northern Ireland and parts of Central Scotland.

The cultivation of flax differs somewhat from that of



Notice that in cool lands the flax is grown for fibre, but in the warm or hot lands linseed is more important.

seed crops. The ground is ploughed, harrowed, and prepared for the seed, which is sown very thickly. This is to cause the plants to be crowded, so that they will grow up without branching out near the ground. When the young plants are about three inches high the fields are weeded by hand. By the early summer the plants are two to three feet high and bear a number of small, bright-blue flowers. After the flowers have faded and the seeds are forming, it is time for the harvest.

Photo : Topical.

BOY SCOUTS HARVESTING FLAX.

Unlike many field crops, flax is harvested by hand, the plants being pulled up by the roots and tied into bundles ready for retting.

Flax is not cut down, as in harvesting other crops, but is always pulled up, usually by hand while the ground is dry. No machines have been invented which can do the work as well as hand-pulling. The seeds are then removed by pulling the heads of the plants through a kind of comb. Care must be taken not to damage the stalks, which are then ready for " retting."

The object of " retting " or " rotting " is to soften and loosen the stringy fibres from the pith or core which they

enclose. Usually the stalks are made up into bundles and packed into ponds or slow-flowing rivers beneath the surface of the water. The sheaves or bundles are held down by a layer of rushes, straw, or turf with stones placed on the top.

Retting takes a fortnight or so, according to the place and the weather. When it is complete the stalks are passed between wooden rollers to break up the pith, and are then "scutched." The object of scutching is to scrape the re-

FLAX

mains of the woody pith from the fibres, which now have a silky cream colour.

In Belgium the finest flax is manufactured at Courtrai. The plants are retted in the river Lys, a slow-flowing tributary of the Scheldt. Russian or Archangel flax is retted by being spread out on the grass for several weeks, exposed to dew and rain. Such flax is brown, but very soft and silky.

The finished fibre is then sent to the big linen-making centres, such as Belfast in Northern Ireland or Dundee in

Photo: Aeroplms.

LINEN MILLS NEAR BELFAST.

Notice that a stream of water flows past and under the factory. The white strips in the fields in the background are pieces of linen cloth bleaching in the sun and air. In the foreground are the homes of the factory workers.

Central Scotland, where it is spun into thread and woven into cloth.

Nowadays linen is not used so much for clothing as it used to be, owing to the discovery of cotton, which is cheaper to produce. The heaviest linen material is sail-cloth, the finest is cambric or lawn. The heavy linen goods such as sail-cloth, canvas, tarpaulins, and sacking are made in Britain at Dundee, Aberdeen, Kirkcaldy, and Barnsley. Lighter linens are used for tents, towels, upholstery, ticking, and so on. Plain woven linen is used for bed sheets, pillow cases, shirts, and collars. Other materials made from linen are damask tablecloths, cambric, and handkerchiefs. These are produced mainly at Belfast, Dunfermline, and Perth.

Linen thread, which is very much stronger than cotton, is used in the manufacture of boots and shoes, saddlery, and all kinds of leather work. It is made mainly round Glasgow and Belfast.

COTTON

Cotton, the upstart, which has robbed linen of its place as a clothing material, has only been known to the Western World for a mere five hundred years. Even then no-one took much notice of the new-comer at first. If one had told a draper in the days of Henry VII. that the time would come when even the poorest of the poor would wear fine cotton cloth, he would have regarded it as a foolish tale.

In those days cotton was obtained from India. No-one knew exactly how it was made, and the wives and daughters of the wealthy traders would spend a small fortune to obtain a length of this Indian cloth. To-day cotton clothes the world, or at least the greater part of it.

The cotton plant is a small shrub which grows best in lands where the weather is both hot and fairly wet. It is,

as we say to-day, a summer rain crop, for it thrives in such a climate. Frost is its greatest enemy. From India, where it is still cultivated in large quantities, the cultivation of cotton has spread to every land where the weather makes its cultivation possible.

Especially has it become important in the New World,

The two most important cotton *exporting* regions of the world are south-east U.S.A. and Egypt. Elsewhere, as in India and China, the fibre is not of such good quality, and most of it is used locally.

and to-day two-thirds of the world's cotton is grown and harvested in southern U.S.A. Another land is Egypt, where cotton has quite displaced linen, and in recent years it has been increasingly cultivated on the rich grasslands near the head waters of the Nile in Uganda, and the Anglo-Egyptian Sudan.

The seed is sown in April in America, and when the monsoon breaks in India, which is in May or June. The young

plants grow rapidly, and the fields need to be continually hoed to keep down the weeds. In Egypt the cotton fields are in the delta of the Nile, and water from the river is allowed to flow along shallow channels between the rows of plants.

After about ten weeks, during which time the plant needs plenty of rain or water, the flowers begin to appear and continue for another ten weeks. As the flowers wither the seeds form and grow within a rounded boll or pod. In America the first seeds usually ripen during August.

As the seeds ripen, the pods open to reveal a fluffy ball of cotton in which the seeds are embedded. Picking must be carried out by hand, for only a few of the pods on a plant are ready for picking at any one time.

During this harvest season, which lasts for a couple of months, the weather needs to be warm and dry. In India this coincides with the ceasing of the monsoon, while in Egypt the flood waters of the Nile are subsiding.

When the cotton has been harvested, it is of no use to the spinners until the seeds have been removed. This is done on or near the plantations, either by hand or by machinery. The process is called " ginning."

Hand-ginning is now only used for the very finest cotton. The rest is ginned by machinery, which, by means of revolving steel brushes, combs the cotton from the seeds. The cotton seeds are crushed to yield a valuable golden-yellow oil, used largely in fish canning. The remains of the crushed seeds is made into slabs of cattle " cake." Cotton-seed cake is a valuable milk-producing food for dairy cattle.

The cotton, having been removed from the seeds, is pressed into huge bales, each weighing 400 lb. or more.

PICKING COTTON IN PERU.

The cotton plant grows wild in South America. It is cultivated on the coast-lands within the tropics, where there is summer rain. Each white, fluffy ball is a seed of cotton surrounded by fibre. The picking must be done by hand, as flowering and fruiting go on for two months or more.

From the plantation ginnery the bales of cotton are sent to the market where, from samples which are taken, the cotton is sold. The bales are then re-made and packed for

shipment. Egyptian cotton bales weigh 750 lb., and are exported from Alexandria.

The raw cotton is shipped to the big spinning centres in America, Europe, or Japan. A large proportion of the Indian cotton is spun and woven in India.

American cotton is exported from ports in the Gulf of Mexico such as Galveston, New Orleans, and Mobile, or from Charleston and Savannah on the Atlantic coast. The largest American spinning area is round Boston, where the damp climate suits the work in the mills.

Cotton, unlike wool or silk, is very brittle, and therefore

Why cotton is manufactured in Lancashire.

it cannot be spun easily by machinery without the threads continually breaking. It was soon discovered, however, that in a damp atmosphere the amount of breakage was very slight. As a result machine cotton-spinning progressed only in places where the weather was damp.

For this reason Lancashire, backed by the Pennines and facing the wet west winds, soon outstripped Yorkshire in spinning the new material. The possession of the deep-water ocean-port of Liverpool, which faces the great cotton-growing lands of America, also helped in the prosperity of Lancashire.

The great development in the production and manufacture of cotton has been due to the invention of machinery

Photo: J. Dixon Scott.

A LANCASHIRE COTTON MILL.

to spin and weave the fibre. For over a century Lancashire was the only place where such machines were working, and so Lancashire made cotton cloth for the whole world.

To-day matters are different. The hard-working, little brown people of Japan, where there are no Sundays or half-holidays, have begun to make cotton cloth, not only for themselves but for their neighbours and for all whom their

Annual Output
COTTON

salesmen can manage to reach. Osaka and Kobé are cities of cotton mills.

India, too, the original home of cotton, is making an increasing quantity of cotton cloth. Cotton is grown all over India, and there are cotton mills in every important city, especially at Bombay.

Even in Europe cotton cloth is now being woven in many places, although the foreign factories still buy their yarn from Lancashire. The largest cotton centres in Europe are Lille, Krefeld, Chemnitz, and Posen.

Russia, which for some years after the War of 1914–18 was occupied in internal revolution, is now not only making its own cotton goods but is actually growing its

own cotton in the hot tropical plains of Turkestan, on the other side of the Caspian Sea. Much of the Russian cotton is spun and woven at Moscow.

SILK

Yet another important clothing material is silk. This is the product of a small white caterpillar or worm whose original home was in China. The Chinese people, with their habit of keeping themselves to themselves, also kept the secret of silk to themselves, and it was not until a few worms were smuggled out of the country in a hollow cane that the spinning of silk was possible outside China.

To-day China and Japan supply more than three-quarters of the raw silk of the world.

The silkworm, which produces the silk, is about an inch to two inches long. It is reared from the eggs laid by the silk moth. The moths are kept by folk who do nothing else but collect the eggs or " silk seed." The eggs are very small. Each moth, which only lives ten days, lays about 500 or more eggs and then dies.

The eggs are so tiny that it takes 48,000 of them to weigh an ounce. They are carefully collected, washed, and stored in a cool place until sold. The rearers of silkworms buy the seed by the ounce. The eggs are spread upon trays which are placed in an incubator. It is important that all the eggs in a tray should hatch out together.

After they have hatched out the young worms are fed upon young mulberry leaves, chopped up very fine. The worms grow at a remarkable rate, and feed even faster. After three days a young worm will eat whole mulberry leaves, and during its life of forty-two days it will eat many times its own weight of leaves.

At certain fixed times, four in all, the worms go to sleep

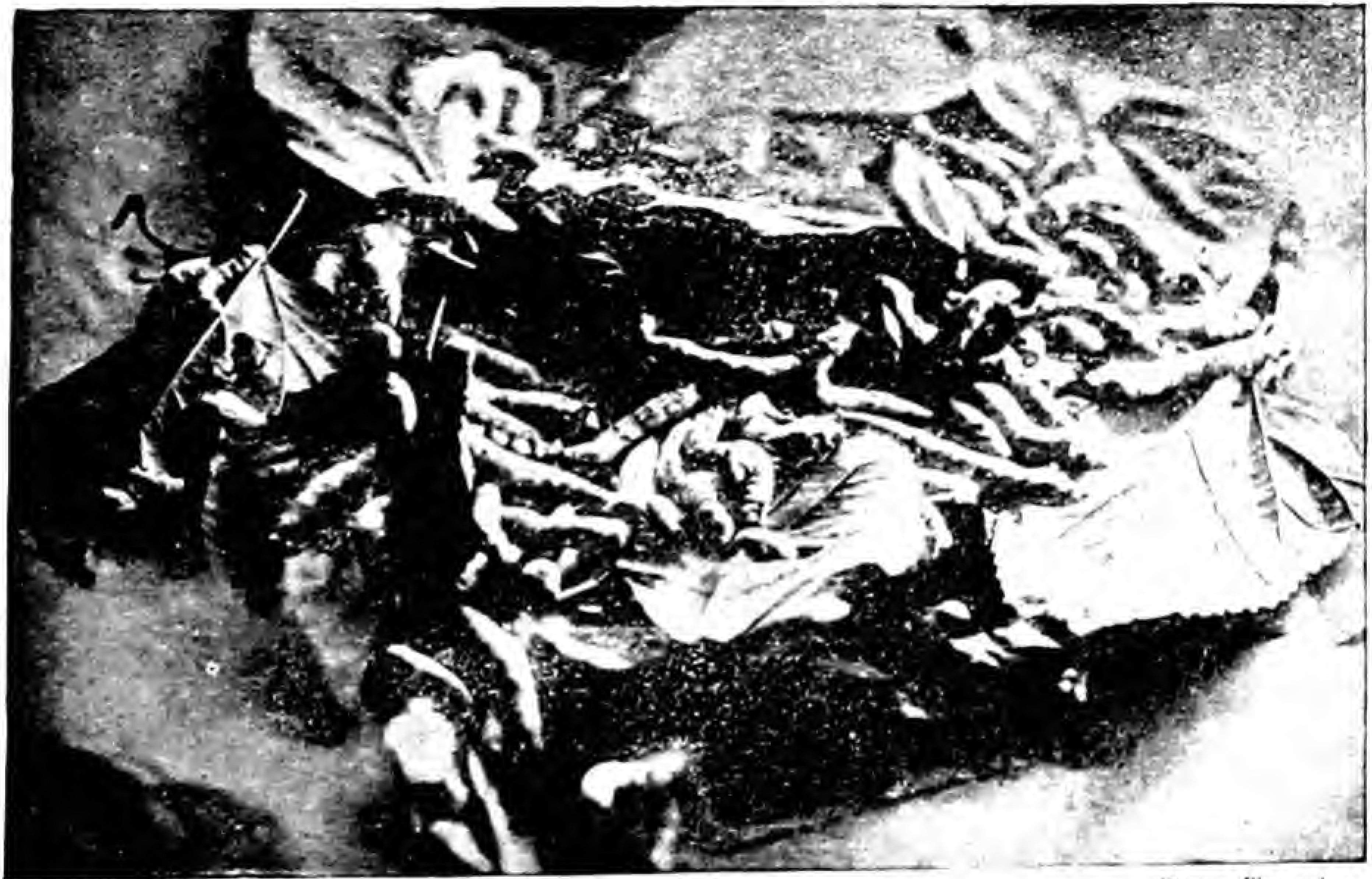


Photo: Topical.

SILKWORMS FEEDING ON MULBERRY LEAVES.

These grubs are nearing the stage when they will begin to spin their cocoons. The worms from an ounce of seed will eat over a ton of mulberry leaves in six weeks, and each worm will produce up to three-quarters of a mile of silk.

for twenty-four hours. When they wake up they crawl out of their old skin and start with a new one. During their last great feed, which lasts for about ten days, the worms eat about twenty times their own weight of leaves.

The worms from one ounce of seed will eat, before they have finished, about one ton of mulberry leaves.

Having accomplished this remarkable feed, each worm gets ready to spin its cocoon. At this time the worm is practically little more than a bag of liquid silk. Indeed the

silk-gut used by doctors and others is obtained by simply pulling out a silkworm to the required length and thickness, dipping it in vinegar, and snipping off the head and tail!

The worm uses its own supply of liquid silk to spin a slender thread half a mile or so in length, which it wraps round and round itself, forming an egg-shaped cocoon. The silk hardens to form a firm, strong shell within which the insect waits for from ten to twelve days. It then bites its way out and emerges as a moth.

Unfortunately, in cutting its way out the insect destroys the silk by cutting it into a few thousand pieces each an inch

or so long. It is necessary, therefore, to kill the insect in order to save the silk. This is done by suffocation. The cocoons are collected and are either steamed, in which case they have to be carefully dried, or they are placed in a current of hot air for a few hours. This kills the insects and dries the cocoon. These can then be put into sacks and stored without risk of damage.

To obtain the silk from the cocoons, about five or six are placed in a shallow pan, containing warm water. This softens the gum round the silk. The worker then takes a stiff brush and gently dabs the floating cocoons. The ends of the silk are picked up by the bristles, and as the brush is lifted the cocoons begin to unwind.

The five or six strands are twisted together, and passed over tiny glass reels to a large frame, which turns round and round. Thus the silk is unwound from the cocoons and twisted into a single round silk thread. This, in turn, is wound into a skein and forms the raw silk which is bought by the factories.

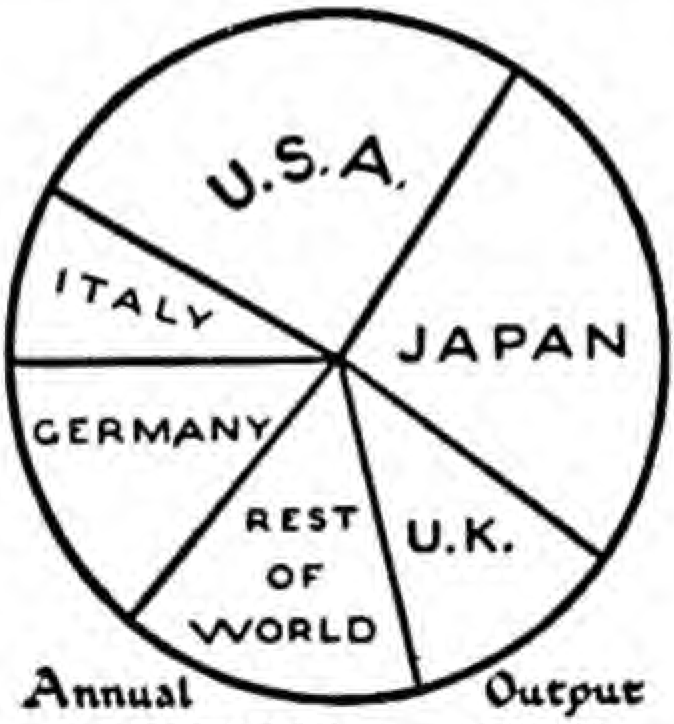
Reeling silk is very skilled work, and is usually done by women or girls. Each skein must be examined for flaws before it is sold. The fluff which surrounds the cocoon is also valuable, and is sold as silk waste.

The largest silk-manufacturing centres in Europe are Lyons in France, Krefeld in Germany, and Genoa in Italy. In England silk is also spun and woven at Macclesfield.

Silk is one of the most useful and valuable of clothing materials. It is very elastic and therefore wears well. It has a soft attractive appearance, and can be dyed and manufactured into all kinds of beautiful fabrics. Silk is also pleasant to wear, being cool in summer, warm in winter, and it does not irritate the skin.

ARTIFICIAL SILK

One might have thought that with the four great fabrics, wool for warmth, linen for lasting, cotton for cheapness, and silk for satisfaction, mankind was provided with all that it needed in the way of clothing materials. In this world, however, folk are never satisfied, and now a new material has been discovered which combines the advantages of several of the older fabrics. This is artificial silk.



Annual Output
ARTIFICIAL SILK

It is made from all kinds of vegetable or plant materials, ranging from cabbage stalks or sawdust to cotton waste. The process is really a repetition, on a large scale, of the way in which the silkworm makes its silk, or the spider spins its web.

The woody material of which the leaves and stems of plants are made is known as cellulose. This is the material of which the artificial silk is made. Just as the silkworm chews up a leaf and digests it, so man has invented a method by which substances containing cellulose are cut or ground up with chemicals and treated with other chemicals, so that a liquid is produced which is similar to liquid silk.

This fluid is then forced through tiny holes, and as it comes

in contact with the air it hardens into a slender thread. There are several methods of making this artificial silk, and the material itself is both cheap and attractive. It can be made in beautiful colours, and is almost as cheap as cotton. The materials from which it is made are really waste, for cabbage stalks and sawdust had no value a few years ago. There is, indeed, every prospect that artificial silk may ultimately replace cotton and silk when large enough supplies of the materials needed are available.

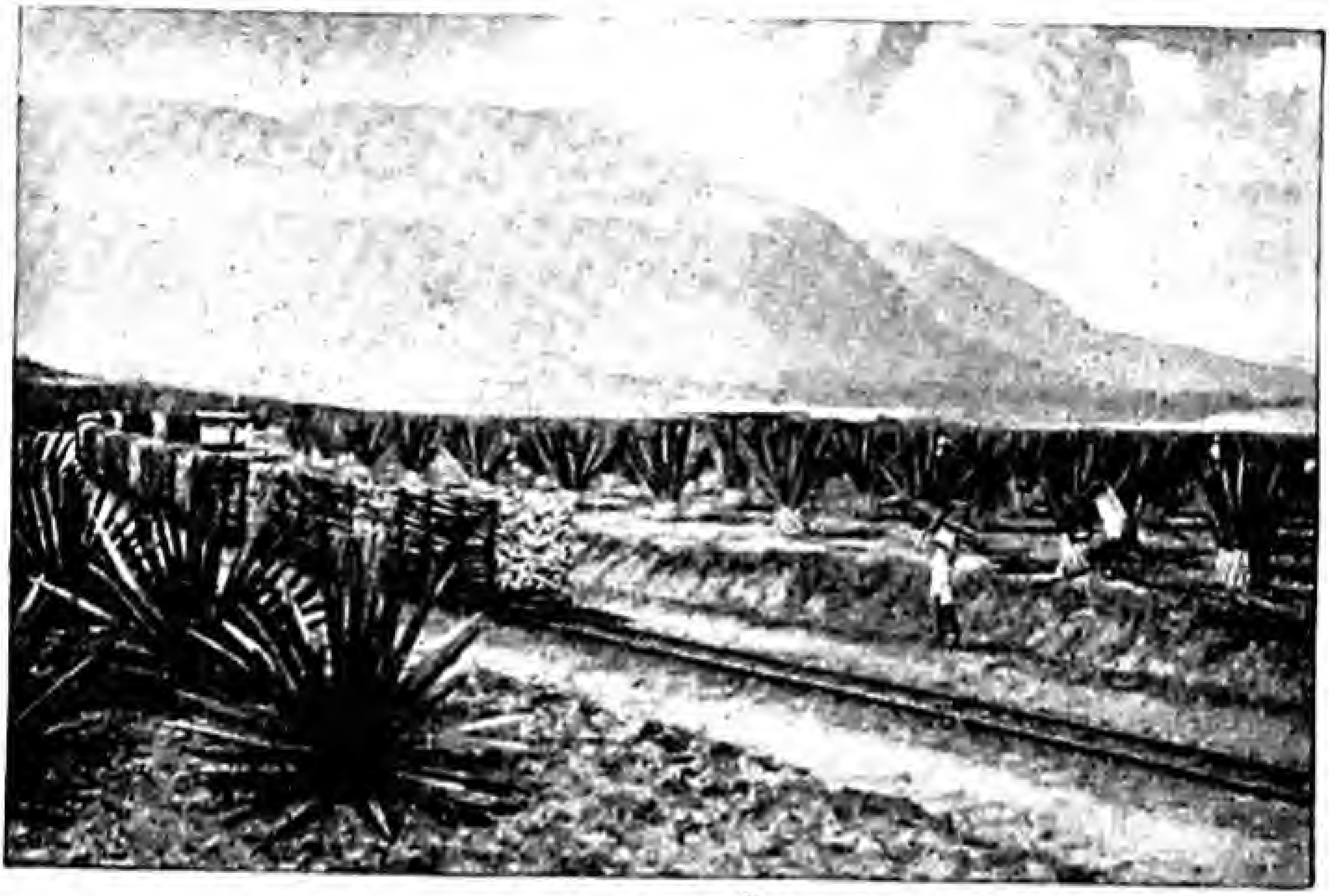
The industry has this great advantage also, over all other textiles, in that it cannot be affected by disease, drought, or insect pests. In Lancashire many cotton mills which were closed for several years have been altered to use the new material. Artificial silk can also be manufactured into knitted goods of all kinds, and this is bringing more work to the folk employed in the hosiery trade at such places as Leicester.

OTHER FIBRES

In addition to these clothing fabrics, there are several other fibres which are spun into thread or cordage, or are woven into coarse sacking or carpets. Jute is made from the stringy covering on the stems of a tall water-loving plant which grows in the delta of the Ganges in India. It is prepared in a somewhat similar way to flax, though the stems of jute are ten feet or more high, and as thick as a man's little finger.

Jute is manufactured largely at Howrah, the big factory district of Calcutta (see map on page 35). For many years it has been the most important manufacture of Dundee.

Rope and cords are made from various kinds of hemp. These fibres are obtained from the stringy parts of the plant. The finest hemp comes from the Philippine Islands, and is known as manila. Another hemp is called sisal, and is



By courtesy of Imperial Institute.

A SISAL PLANTATION IN EAST AFRICA.

The sisal plant is a native of Yucatan, in south-east Mexico, and grows well on the high, dry tableland of East Africa, where the black farmers have been taught to grow it. The stiff, sword-shaped leaves are cut with heavy knives and are then transported on a tramway to the factory, which can be seen in the background, where they will be crushed between rollers to break up the pith, leaving the tough, stringy fibres from which cord and rope are spun. This is a plantation owned by a white farmer, but there are hundreds of native farms, both in Tanganyika and also in the Transvaal, where sisal is grown and prepared entirely by the black folk themselves.

obtained from the large, fleshy, sword-shaped leaves of a cactus-like plant which grows in Central America.

Sisal is now being grown with great success in Jamaica, where the planters had to find a crop to replace sugar-cane. It has also been introduced into East Africa. It is a crop which natives can cultivate, harvest, and prepare for the market without white assistance. As a result sisal has become the most important export from Tanganyika Territory. Sisal cord or rope is unaffected by sea water, so it is in great demand for ships' ropes and cables.

CHAPTER XII

THE HOUSE THAT JACK BUILT

IN addition to providing themselves with a great variety of food and drink from the world around them, and contriving most ingenious, convenient, and attractive clothing from nature's resources, men have also had to provide homes for themselves. These homes reveal amazing differences, according to the surroundings of the builders, the materials that are available, and the weather they have to withstand.

Indeed, an exhibition of the different kinds of houses to be found upon the earth would make the average person feel like Alice in Wonderland.

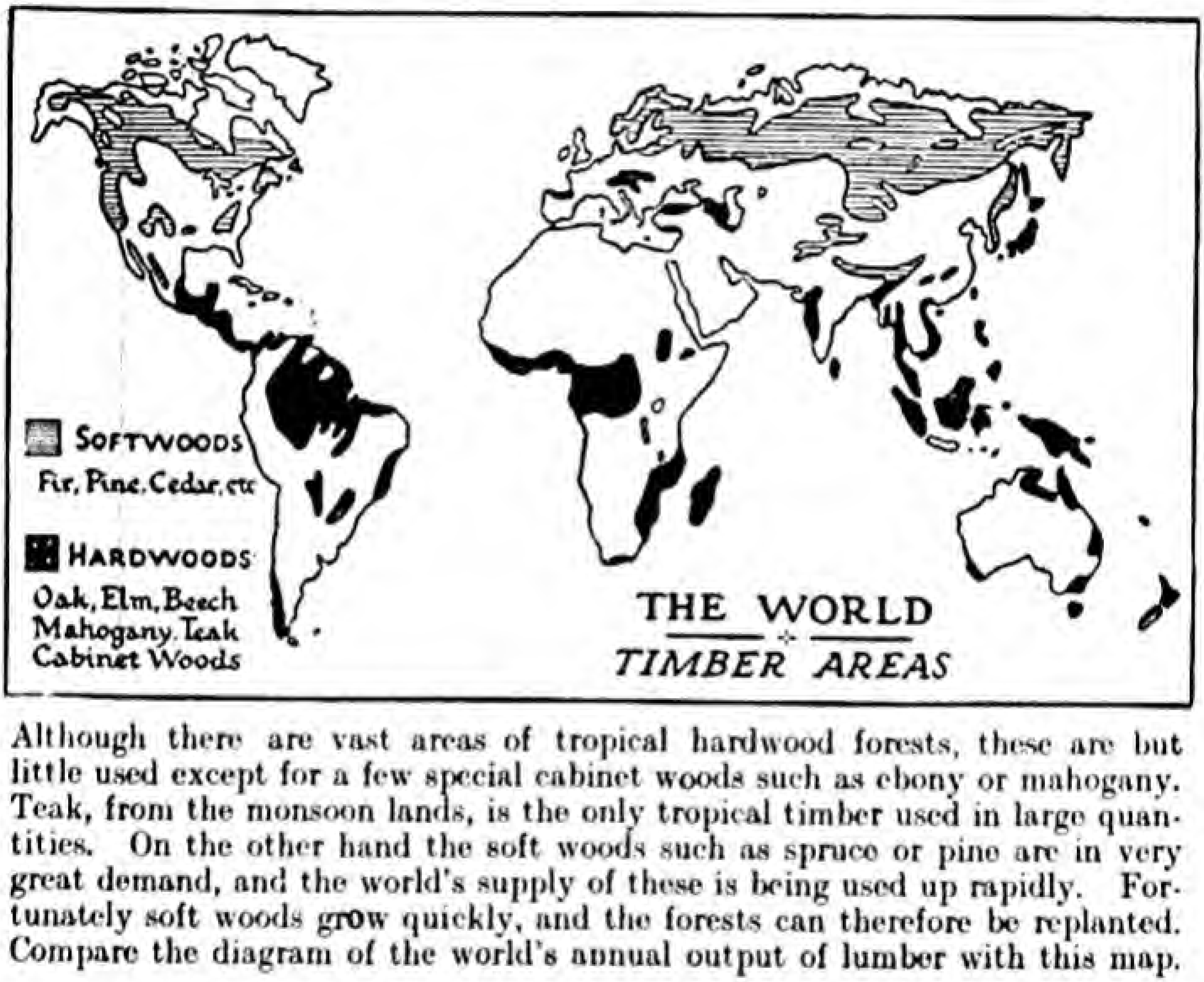
Some folk live in underground burrows like those of a rabbit, others imitate the birds and live in a nest on a tree-top. Some houses have roofs but no walls, others have walls but no roof. The materials used range from grass, mud, or snow, to stone, steel, and glass. The buildings themselves range from one-roomed bungalows to towering skyscrapers housing several hundred people.

In this book we are more concerned with the buildings in which ordinary folk live and work in a busy land such as Britain.

The earliest homes, after men gave up living in caves, seem to have been small huts with walls of turf and stones, and with a roof of branches and bracken. This kind of house,

with very little improvement, is still to be seen in out-of-the-way corners in Scotland and Ireland.

The Romans were the first real house builders in Britain. They got their ideas from other peoples such as the Egyptians and Greeks, and introduced the idea of building as we know it to-day, using bricks and concrete. A few of the old Roman buildings, or bits of them, are still remaining; but it so



Although there are vast areas of tropical hardwood forests, these are but little used except for a few special cabinet woods such as ebony or mahogany. Teak, from the monsoon lands, is the only tropical timber used in large quantities. On the other hand the soft woods such as spruce or pine are in very great demand, and the world's supply of these is being used up rapidly. Fortunately soft woods grow quickly, and the forests can therefore be replanted. Compare the diagram of the world's annual output of lumber with this map.

happened that their ideas on home-making did not correspond with those of our Anglo-Saxon forefathers. These fighting forest-dwellers disliked and distrusted the large villas and temples of the Roman officials and gentry. They were half afraid the walls might collapse or the roof might fall in, for the Romans had an ingenious method of building in which timber was hardly ever used. On the other hand the Saxons

used timber for the main framework of their houses, filling in the spaces with dried mud, or with basket-work. Where the Romans used tiles the Saxons preferred thatch.

In our modern homes both methods are used. The foundations and walls are made of brick, stone, or concrete, while the framework of the floors, ceilings, and roof is of timber, often covered with plaster, the successor to the dried mud of our ancestors.

In other northern countries, and especially in those lands where timber is plentiful, the whole house, including the roof, may be of wood. Timber, therefore, is one of the most important house-building materials that man has yet discovered, and the great bulk of the trees felled in the forests of the world are used in the building trade.

The world's greatest forests of useful timber are found in a vast belt round the fringe of the Arctic lands. For thousands of years they remained untouched, for the people of temperate lands found plenty of trees growing near at hand. Nowadays, however, the forests of Europe, except in certain mountainous districts, have been largely destroyed, and so we have to go farther afield for our timber.

The forests of Canada, Scandinavia, and Russia supply huge quantities of timber, and tens of thousands of workers are employed in the lumber camps and sawmills, or on the rivers and railways by which the timber reaches the ports.

Modern lumbering is carefully controlled by the governments of the lands where the forests are found. This is very necessary, for to-day the world is using timber at an enormous rate—faster than it can be grown. If the lumbermen were allowed to do what they liked, the forests of the north, vast as they are, would in time be destroyed like those of warmer lands.

So the lumbermen work under a licence or permit from the

Photo : Canadian Air Board.

LAKES AND FORESTS IN ONTARIO.

There are vast stretches of coniferous forest in Eastern Canada. The timber here is transported by water on the lakes or rivers (see picture on page 163). On the Pacific coast the lumber has to be hauled by train or tractor. The lakes of Eastern Canada provide unlimited resources of water-power for big electricity stations. Notice the dam.

government concerned. They may only cut down trees of a certain size, and must keep to definite areas of forest. Meanwhile young trees are planted to replace those that have been cut down.

The timbers most in demand for house-building come from coniferous trees such as pine, fir, or spruce. These trees grow with tall straight trunks, and can be cut up into posts, boards, or planks without much difficulty. The wood also is easy to work, so that it can be cut, planed, and jointed easily.

The United States is the world's greatest producer of

timber, by far the greatest part of which comes from the forests of the Pacific coast. Here, where the west winds bring their rain, is a land of forest-clad mountains and rushing rivers. The trees, as in British Columbia to the north, are felled by gangs of axe-men working in pairs. The fallen trunks are then trimmed, the branches being lopped off and the logs sawn into convenient lengths.

Haulage is usually by caterpillar tractors to a light railway which carries the logs to the sawmill. On the whole, the

LUMBER: ANNUAL EXPORT.

rivers of the Pacific coast are too swift to be used by timber rafts. Where water is used at all for transport it is in a "flume." This is a boarded channel, running down the mountain side to the lake beside which the sawmill is built. The water from a small stream is diverted to flow down this trough, and the logs are shot down the flume.

The sawn lumber is usually sent by railway to the large ports, such as Seattle and Tacoma on Puget Sound, but a few of the big lumber companies have their own shipping wharves on some convenient bay or estuary. Vancouver handles most of the British Columbia timber.

Photo : Canadian National Railways.

A CANADIAN LUMBER MILL.

These logs have been floated down from the lumber areas, and are awaiting handling in the mill. They will be dragged up by creeper-chains into the sawmill, where they will be cut up into posts and planks, or peeled into thin layers for plywood. The smaller logs may be cut up into short pieces, ready to be crushed into pulp for papermaking.

Canada is the Empire's greatest timber land, and is third among the world's producers of sawn lumber. The forests extend in an almost unbroken belt from Nova Scotia to the Pacific; but the greatest lumbering areas are in Eastern Canada (especially in Quebec and Northern Ontario) and in British Columbia. The eastern area lies mainly in the basin of the Ottawa River, which is Canada's greatest lumber

river, although the St. John River in New Brunswick is also very important.

The Ottawa with its tributaries drains 130,000,000 acres of forest, and in spring and early summer millions of logs are floated to the sawmills.

On reaching the mill the logs are collected in a pool, from which they are hauled by a spiked conveyor or "jack-ladder." As they ascend they are sprayed with water to remove any dirt or grit which would dull the saws. Powerful steel arms "kick" the log on to a travelling carriage or platform. This slides rapidly towards a band-saw which squares it ready for cutting into boards.

Lumber for export may continue its journey from the mills to the port by river. Ottawa, the Canadian capital, is built near the junction of the Gatineau and Ottawa rivers, and is therefore a great collecting centre for lumber.

Other big Canadian timber centres are Saint John at the mouth of the St. John River in New Brunswick, and Halifax, the port of Nova Scotia. There are also a number of big sawmills and lumber-shipping wharves along the St. Lawrence River.

Russia, which may be described as the Canada of the Old World, is also a big producer of timber. The world possesses about five and a half billion acres of forest, and of this over one quarter is in Russia. From the Baltic in the West to Kamchatka in the Far East stretches a vast belt of forest, which is at present supplying one-sixth of the world's timber.

Under Soviet rule, modern methods of lumbering have been introduced here and there, and great efforts are being made to develop the forest resources.

One of these modern inventions is the mechanical saw, the teeth of which are mounted on an endless chain almost

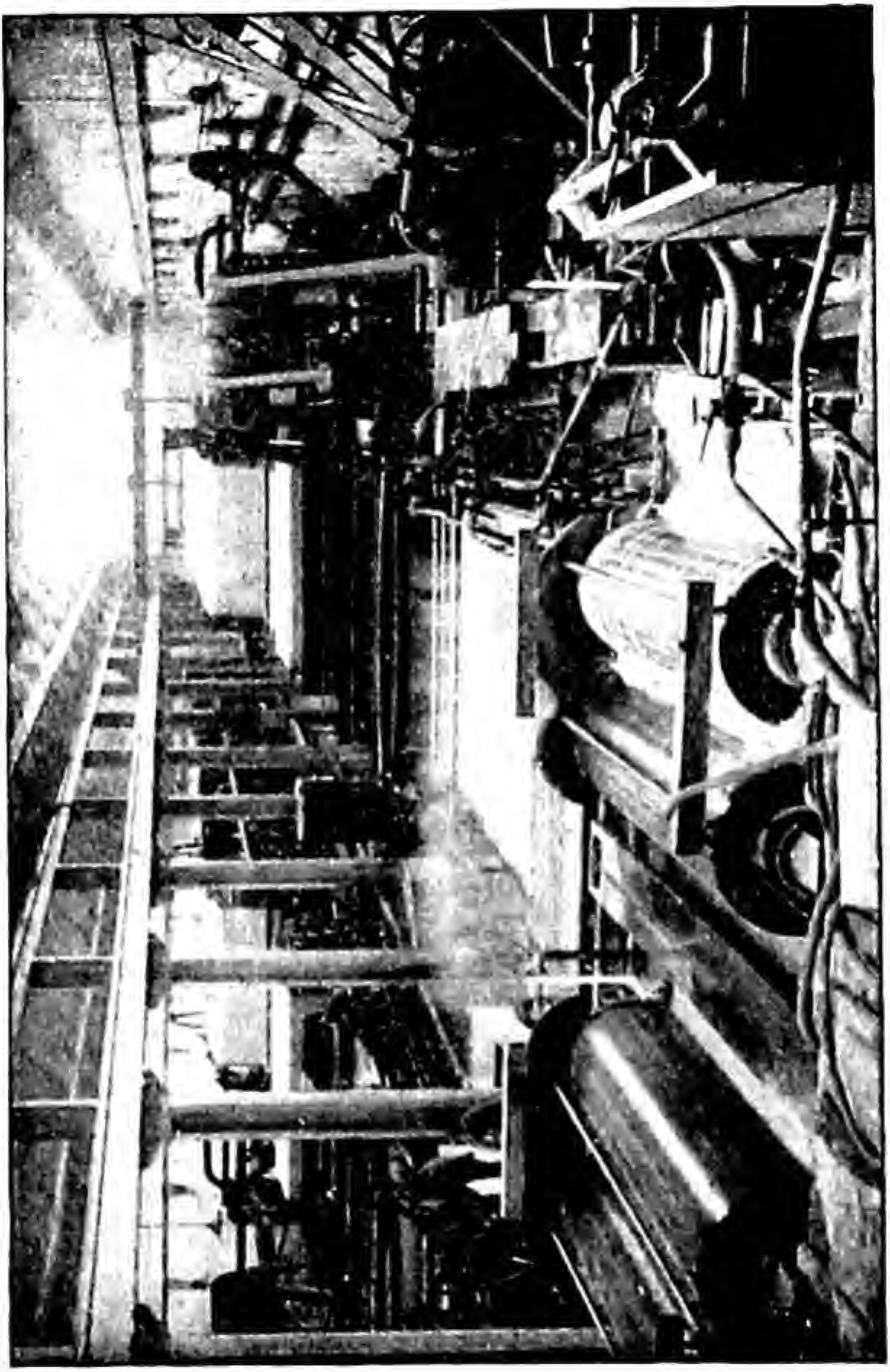
like a cycle chain. The driving power is provided by a small petrol motor.

Lumbering is largely a winter occupation, because at that season men can be spared from the land, while the snow renders the haulage of the logs easy. It is also possible to accumulate large stacks of lumber beside the frozen rivers, ready for the spring floods from the melting snow to carry the logs to the mills. The climate of Russia is very extreme, with severe cold in winter.

Unfortunately, practically all the rivers in the Russian forest zone flow northward into an ice-bound sea. They cannot, therefore, be used to float the timber all the way to the ports, as is possible in Canada and western U.S.A. To meet this difficulty, a timber railway has been constructed running east and west between the rivers of European Russia and the Baltic. Viatka and Vologda are two big lumbering centres, and branch lines run northward to Archangel, and to the ice-free port of Murmansk.

The Baltic countries of Sweden and Finland also supply vast quantities of sawn timber, much of which comes into the east coast ports of Britain. The methods of felling and milling are much the same as in North America and Russia. A considerable proportion of Scandinavian timber is also used for wood pulp, from which paper is made.

Wood supplies by far the largest portion of the world's papermaking materials, and each year nearly fifty million tons are used for this purpose. The kinds of wood which are in greatest demand are soft woods from the great coniferous forests of Europe and North America. Fir, spruce, poplar, and aspen are most used, and since the wood has to be chopped or ground into small pieces, timber can be used which is of little value for other purposes. Logs for pulping are much smaller than those for lumber.



INSIDE A PAPER MILL.

Having arrived at the mill the logs are sawn into uniform lengths and then enter the debarking machines, which remove the bark. They then pass to the chopping machines. The logs are drawn into the machines by travelling teeth, and cut up into small chips about half an inch in size. The chips are next bruised or crushed between rollers, before being boiled for several hours with chemicals, which not only disintegrate the wood into fibre but also bleach it.

The boilers are of enormous size, capable of dealing with thirty tons of chips at a time, and are heated by steam under high pressure. The pulp is then rinsed, allowed to settle, and is finally dried into large slabs. In this form the pulp is sent to Britain to the paper mills. Nowadays much wood pulp is also used in the manufacture of artificial silk. Newfoundland is another important lumbering area which supplies wood pulp and paper for the printing industries of both U.S.A. and Britain.

Most of the timber obtained from the northern forests is what is described as soft wood. The forests of warmer lands are of hardwoods, such as oak and walnut, which are used for furniture. Most of the oak used in Britain is cut from the forests on the slopes of the Carpathian Mountains. There are also valuable hardwood forests in southern and south-eastern U.S.A.

Australia possesses extensive forests of valuable timber. These lie in a belt along the east coast, which receives the heaviest rainfall, and in the south-east and south-west of the continent. The majority of the trees are hardwoods such as iron-bark, red gum, jarrah, and karri. They belong mainly to the eucalyptus family, and unlike the hardwoods of the Old World, they grow rapidly. It is estimated that an Australian gum will make more wood in twenty-five years than an English oak does in two hundred years. Australian

Photo: Commonwealth Govt.

HARDWOOD GIANTS IN SOUTH-WEST AUSTRALIA.

The forests in the south-west peninsula of Western Australia are of karri or jarrah, two hardwoods which are especially valuable for street-paving and for bridge or pier building. Notice the height of the trees compared with that of the men beneath them. Much of the timber from this region is exported from Albany.

hardwoods have many uses. Iron-bark is true to its name, for it will not burn, and is intensely hard. It is used for building purposes, for railway sleepers, and for bridge building. Jarrah and karri, which grow in the south-west peninsula of Western Australia, are also very hard, and are used for wood-paving blocks as well as for building.

Because gum trees grow so quickly, many small country schools in Australia fence in fifty acres of "bush," and plant two acres of trees a year. In twenty-five years the trees are ready for felling, and the school can make a steady income of £200 a year by selling the timber from two acres each year. The woods grown in this way are usually soft woods.

Mahogany is a dark reddish-brown hardwood obtained from a large tree which grows in West Africa and in the West Indies. The best Spanish mahogany comes from Cuba, but the largest source of supply is British Honduras, a small colony slightly larger than Wales, on the east coast of Central America. Mahogany is the most important export from this rather hot, damp area. The timber is of great size, and is often most beautifully figured.

The West African mahogany areas form a long narrow belt parallel with the coast, from Gambia to the Cameroons.

Owing to the value of mahogany, its use for solid furniture or fittings is far less to-day than fifty years ago. Instead, it is made into veneer with which to cover a cheaper wood.

Another tropical hardwood is teak, which is one of the most valuable of known timbers, and has been used in the East for at least two thousand years. It owes its value to its ability to resist decay and its freedom from damage by insects. In certain cave temples in Western India, pieces of teak have been found which are estimated to be over two thousand years old.

This durability has led to a large and increasing demand

for the timber for use where great strength and security are needed. Teak is, however, not proof against the borings of the teredo or ship-worm, and although used extensively for piles and harbour works, as well as for ships, it is usually sheathed with copper to protect it from the attacks of this creature.

The teak tree grows in monsoon countries, especially in

Photo : Commonwealth Govt.

LUMBERING IN QUEENSLAND.

Queensland has very valuable forests of hardwood. The timber is often of great size, and the logs are usually hauled by caterpillar tractors or by teams of oxen to the mills.

Burma, India, and Siam, and is never found near the sea. In Burma large plantations are now being maintained. The tree grows rapidly, reaching a girth of six feet in about one hundred years.

Usually the trees are ring-barked (*i.e.* the bark and sapwood are cut through near the ground) to kill them, and

felled two or three years later. This enables the timber to dry, otherwise the logs would be too heavy to float down the rivers. Elephants are used for handling the logs.

The world's main supply of teak is exported from Rangoon and Moulmein, with a small quantity from Bangkok. Almost the whole of the Indian supplies have been exhausted.

In addition to yielding timber, certain varieties of coniferous trees yield valuable gums or resins, which exude from the trees. From these resins turpentine and varnish are manufactured. In Europe, the largest supplies of resin (or rosin, as it is also called) are obtained from the "cluster pine" in the Landes district of France, near Bordeaux.

This region, which was once a barren waste, is a triangular peninsula, seventy miles in length, between the Gironde estuary and the Bay of Biscay. Here, over a century ago, were begun the pine plantations which now yield 100,000 tons of resin and 25,000 tons of turpentine annually.

The resin is obtained by chopping out a cup-shaped hollow in the trunk of the tree about a foot from the ground. A gummy fluid collects in this pocket, while more gum solidifies about it. This is removed by scraping. The fluid and gum are taken to a factory for distillation.

The vapour is condensed to form oil of turpentine, the familiar "turps" of commerce, while the resin remains as a pale amber-coloured solid. Usually a pine tree is tapped for three years, and is then allowed a rest for several years, so that it may recover. Varnish, tapers, and sealing-wax are manufactured from this product of the pines. The whole industry is an interesting example of the way in which barren lands may be made productive.

The great demand for timber of all kinds has led to the devastation of most of the more important forests of the world, and it has been found that serious and unexpected

results have followed the disappearance of the trees, for forests exert a very great influence upon both climate and soil. The present desert character of much of North Africa and Syria is due largely to the destruction of former forests, while in North America large areas of mountain country have become waste, owing to the soil having been swept away after the trees were cut down.

The air over forests is both cooler and damper than over open country, and this difference increases with altitude. One result is that winds similar to land and sea breezes occur between forests and the adjoining areas, causing heavy dews and fogs. These fogs render spring frosts less dangerous, while summer hail is almost unknown. Winds passing over forests in valleys collect much moisture, and this helps to increase rainfall in the lee of the forests. In mountainous regions forests tend to increase the rainfall.

Forests also protect the soil, especially on mountain slopes, from the action of floods or heavy rain. Hence if forests are destroyed, great changes occur in the climate and soil of the whole locality.

Most countries recognise the need, not only for the replanting of forests, but for the establishment of forests in barren regions. France and Holland have planted pine forests in sandy coastal districts to protect the fields behind them. In Britain, afforestation is being carried on mainly in Scotland and in Wales.

Timber is not the only building material, although it is very important. The walls of our houses are made of stone or brick, held together with mortar. In parts of Britain where stone is plentiful it is the natural material for building. Limestone and sandstone are most commonly used.

The stone is quarried locally, often by the builder, and is delivered at the site for the mason to trim and dress. Usually

DINORWIC SLATE QUARRY.

the stone is used just as it comes from the quarry, whether the pieces are large or small. The mason places the flat surface of the stones to form the faces of the wall, and fills in the space in the centre with chippings and rubbish.

In most stone-built houses the walls are over a foot through, and often nearly two feet in thickness. Such walls are very strong but are apt to absorb the damp. The inner surface of the wall is, of course, covered with plaster. The corners and the sides of doorways and windows are usually built of sawn stone, called quoins, which have been trimmed at the quarry. In some districts, especially in the Cotswolds, thin slabs of stone are also used for the roofs of the houses.

In most parts of Britain, however, stone is not readily obtainable, so that bricks and tiles are much used. The Babylonians were the first brick makers. They used clay, dried in the sun or baked in an oven. Nowadays, although

A POTTER AT WORK.

This workman has just finished shaping the vase, which is still on the potter's wheel. It will be removed on a "slice," and carefully carried away to dry. After a fortnight or so in the drying-sheds it will be taken to the kilns to be "fired."

bricks are mainly made of clay, all kinds of other material are mixed with the clay.

In a modern brickworks the clay is dug from a large pit and carried to the surface by trucks running on a narrow tramway. In some works the clay is weathered by being left in great heaps exposed to the sun and air, but usually the demand for bricks is so great that the clay is used up as fast as it can be dug.

The clay is ground up with water in powerful machines

which mix it to a stiff paste. From the mixers it passes to another machine, where it is squeezed out through a rectangular opening the size of a brick. As the thick square "sausage" of clay comes slowly from the machine, it is cut up by wire frames into pieces the exact size, and these are carried away on boards to dry.

The weather has a great effect upon brick making, as the works cannot make more bricks than their drying-grounds can hold. Wet weather hinders the drying of the bricks, and so may hold up the whole works. Bricks take as long as three weeks to dry. When the bricks are properly dried they are packed into large cone-shaped ovens or kilns to be "fired." The baking takes from two to three days. In some works the bricks travel slowly through the ovens, which are kept heated the whole time. Roofing-tiles are made in the same way, though they are often moulded by hand.

Although bricks, timber, and stone are still used for building houses, the very large blocks of factories and offices in our modern cities, and the hotels and railway stations, are now usually built of another material. This is concrete, the material used by the Romans.

Concrete is a mixture of sand and stone with cement, a substance which after it has been mixed with water, sets as hard as stone.

Cement, or Portland Cement, to give it its proper name, is made by burning broken limestone and clay together in a kiln or furnace. The clinker, when cold, is then ground to a very fine powder, which forms the cement. A great deal of care is necessary to make sure that the rock materials are thoroughly crunched and that the mixture is mixed evenly. The strength of the cement depends upon the fineness to which it is ground, and it is usually made so that it will pass through a sieve having 32,000 meshes to the square inch.

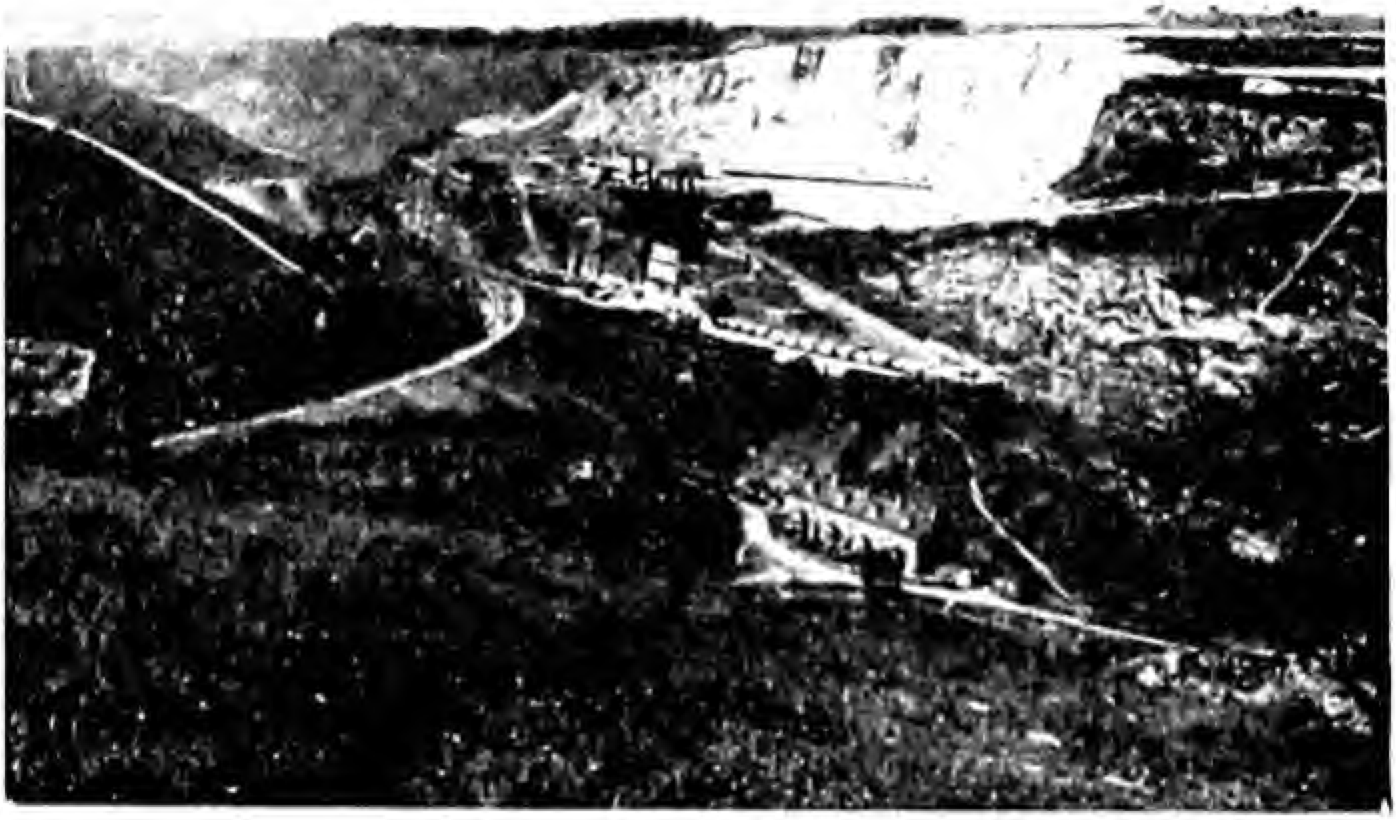


Photo: Fox Photos Ltd.

QUARRYING LIMESTONE FOR CEMENT.

A view of Blackham Hill quarries, in the Peak District of Derbyshire

The framework of the building is made of steel, and the wet concrete is poured between shutters or boards, so as to form a wall with the steel girders or bars in the centre. After a few days the boards or shutters can be taken down, leaving a solid concrete wall. The walls are cast a piece at a time. Floors and ceilings can be made in the same way. In fact, nowadays, concrete is used for all kinds of construction, from pavements to bridges. The great advantage of concrete buildings is that they can be erected more rapidly and more cheaply than ordinary brick or stone buildings. Moreover they are strong and fireproof. The huge skyscrapers in American cities are all constructed of steel and concrete.

Chapter XIII

METALS

THE discovery and use of metal has helped to make the modern world what it is. Look around you and notice the things which are made of metal, or have been made with the help of metal tools and machines. The story of the use of metals is the story of the advance of civilization.

The first workmen used stone—stone hammers, stone choppers, even stone knives and stone-tipped spears. Then someone discovered copper, a fairly soft red-tinted metal that could be shaped more easily than stone. Next came bronze, a harder kind of copper that was actually a mixture or alloy of two metals, tin and copper. The Romans carved out their Empire with bronze swords, and were, in turn, carved up by some enterprising warrior peoples who used iron swords.

Iron held the field for a long while. In fact, until the middle of the nineteenth century iron was supreme. Men used iron for machines, for tools, for bridges, for ships. Then two great engineers each discovered an easier way of making steel from iron, so that nowadays steel is the most important metal used in making things. We have steel machinery, steel buildings, steel ships, and most of the things which twenty years ago were made of iron are now made of steel.

The march of progress has not halted with the use of steel, for now another metal has come into general use. This is aluminium, which is light, fairly strong, and will not

rust like iron or steel. Certain metal alloys of aluminium are now manufactured which are almost as strong and tough as steel, and so the march of progress goes on.

All these metals are obtained from the earth by choosing certain kinds of stone and burning them in a furnace. These stones are part of the earth's crust. In some places they are found on the surface of the ground, in others the stone

IRON MINING AREAS OF THE NORTHERN HEMISPHERE.

Most of the iron supplies of the world are found in North America and in Europe. Big ore-producing areas are in Minnesota (Great Lakes), Lorraine (Eastern France), Sweden, and Algeria. There are important iron areas in the Southern Urals. In the Far East the most important producing areas are near Hankow (Central China) and in Southern Manchukuo.

or "ore" has to be dug out of deep holes or mines. The folk who do this are the miners.

The work of a miner depends very much upon the kind of mineral he is seeking. Some minerals are found in the form of great masses of stone. Others are embedded as layers between other kinds of less useful rock. Some minerals or metallic ores are so soft that they can be dug out of the ground with a shovel. Others are so hard that only a charge of powerful explosive will move them.

All the rocks of the earth's crust contain metals in some form or another, but in many cases the amount is quite small. The work of obtaining the metal is considerable, and so only those rocks are used which contain sufficient metal to make it worth while. Such rocks are called "ores."

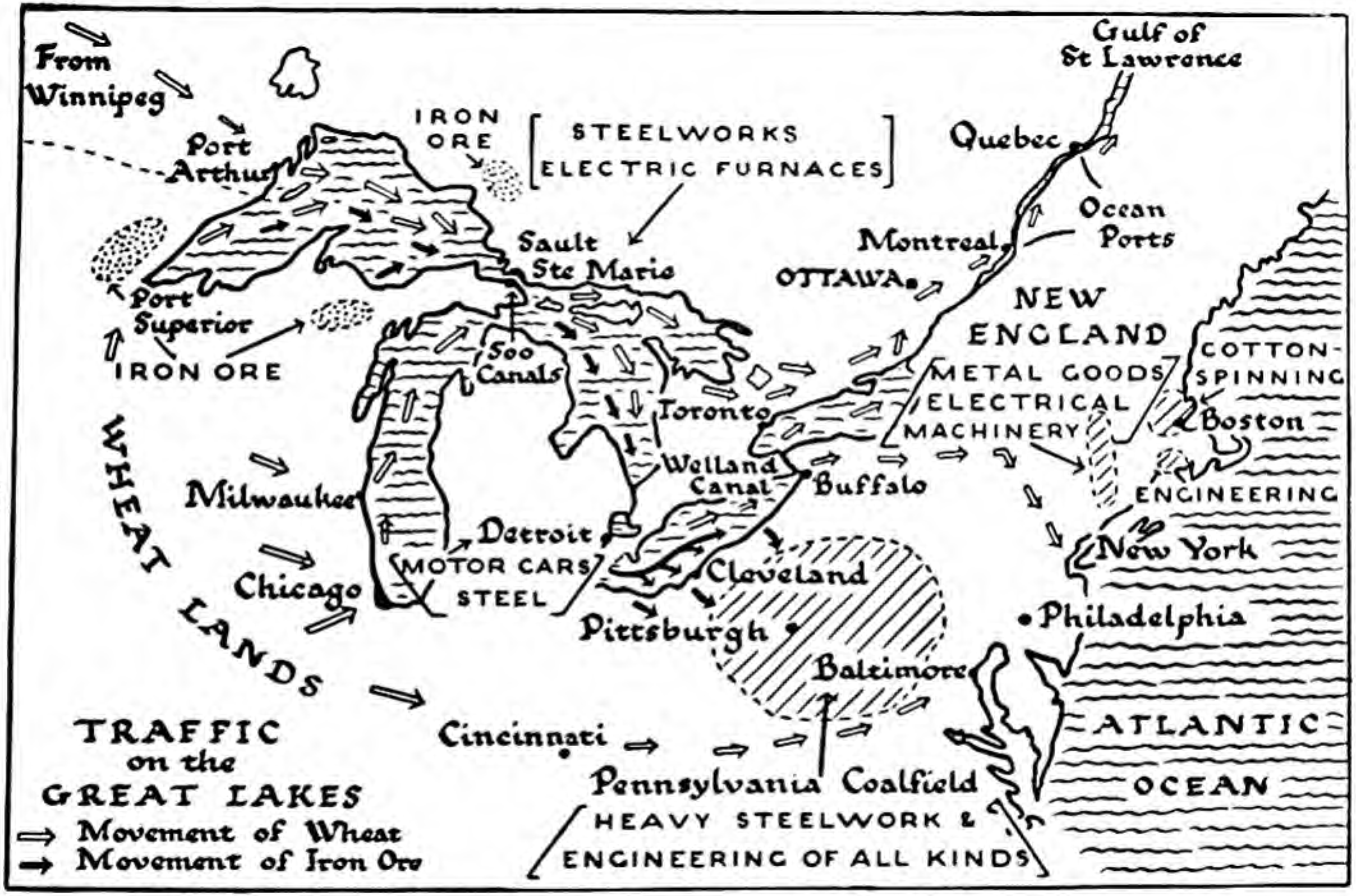
IRON AND STEEL

Iron ore is the most common of all the metallic ores. It is found almost everywhere, but only the richest ores are worked. The largest ironfields are found in the Northern Hemisphere, in North America, Europe, and Asia. The possession of large quantities of iron ore gives a great advantage to certain nations, since both iron and steel are needed for the everyday work of the world. Nations without iron or steel have to buy from those who possess these metals.

Iron or steel cannot be made, however, without coal. About three tons of coal are used in making one ton of steel, so that the possession of supplies of suitable coal is another matter of great importance. Not all coal can be used for steel-making, which requires a special kind of "coking coal." This is only found in certain places, and it is these places which have become the great steel-making centres of the world.

In such centres the iron ore is usually brought to the steel works from the nearest ironfield, which may be many miles away.

The most important ironfield in the world is in North America. It is at the western end of Lake Superior in the state of Minnesota, U.S.A., and close to the Canadian border. Here there are wide belts of iron ore several miles in length. Where these belts are near the surface of the ground, the



TRAFFIC IN IRON ORE AND WHEAT ON THE GREAT LAKES.

The annual volume of traffic on the Great Lakes of North America is more than five times that on the Atlantic Ocean. Cargo ships of up to 20,000 tons are used. Notice the position of the Welland and Soo Canals.

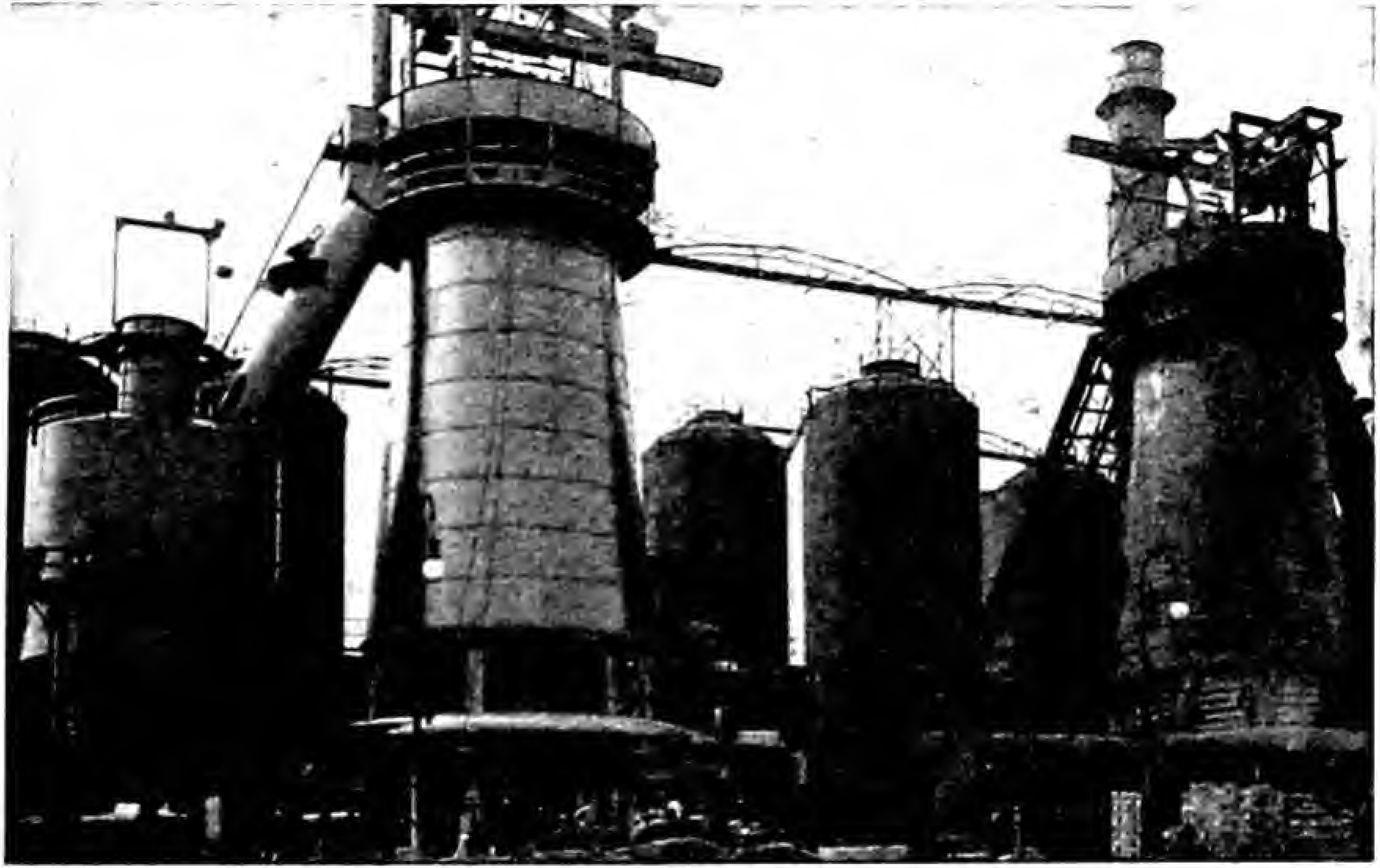
ore is dug out by huge steam shovels which load it straight into large, open railcars, each holding from fifty to sixty tons, ready for transport to the steelworks. More than one half of the ore is mined in this way. There are, however, some belts of ore, or " ranges " as they are called, which dip down very steeply into the ground. In these the ore has to be mined by sinking deep shafts and galleries. Some of the ore is raised from a depth of 3,000 feet. When brought to the surface it is stored in huge bins, and is loaded from time to time into the railcars.

The Minnesota ironfields are about 1,000 miles away from the steelworks, which are in Pennsylvania, on the eastern side of the Great Lakes near Lake Erie. Here there is a vast coalfield in which a great deal of good coking coal is mined. The iron ore has therefore to be carried across the Great Lakes before it can reach the steelworks.

The first stage in this journey is from the ironfields to the shores of Lake Superior, near Duluth, where there are long lines of storage bins built out like piers into the water. Whole trainloads of ore can be emptied into the bins within a few minutes.

When the bins are full, an ore boat draws up alongside them. These ore boats are huge oil-driven motor barges the size of an ocean-going steamer. Each boat holds 10,000 or more tons of ore. There are several large sliding hatches on the deck. These are opened beneath the bins and the ore spouts down into them. A 10,000-ton ore boat can be loaded in this way in twenty minutes.

The next stage of the journey is across the lakes to the unloading ports on the south shore of Lake Erie. On this journey the ore boats must pass from Lake Superior to Lake Huron, which is at a lower level. Fortunately the two lakes are joined by the St. Mary River, and this channel has



MODERN BLAST FURNACES.

This picture should be compared carefully with the section of a blast furnace on page 185. The arrangement for hauling trucks of ore, coke, and stone is on the far side of each furnace. It can be seen behind the furnace on the right. The wide sloping pipe coming from the top draws off the hot gases into the dust extractor on the left. From this the gas goes to the ovens in the background, and back to the ring of water-cooled nozzles surrounding the foot of the furnace.

been deepened, where necessary, in order that the big lake vessels may pass. At one point the river drops over twenty feet in less than one mile, and here two great ship canals have been constructed with five huge locks. These are the Soo Canals (a name shortened from the French name Sault Sainte Marie, or the Falls of St. Mary).

The Soo Canals are the greatest shipping highway in the world. Although for four months of the year the Great Lakes are frozen and no shipping can move, for the rest of the year the canals are crowded. Each season 25,000 vessels, most of them very large, pass through the canals, an average of over one hundred a day. This is five times the number of ships using the Suez Canal in a year, while the weight of goods carried is about three times heavier.

Most of the ships passing eastward through the Soo Canals carry ore, wheat, and timber. On their return they bring back manufactured goods, machinery, and steel.

Two of the locks on the Soo Canals are the largest in the world, being more than a quarter of a mile in length and eighty feet wide. The drop in the river is also used to provide water-power for a big hydro-electric station which supplies electricity for a hundred miles around.

After passing through the Soo Canals, the ore boats cross Lake Huron to its southern end, where they enter the St. Clair River, which they follow to Detroit, the great motor-car city of the United States. Here some of the ore is unloaded to supply the steelworks. Other ships continue on to Lake Érie, where they unload the ore at various harbours along the southern shore of the lake.

As the lakes are closed by ice during the winter the ore is dumped in huge piles beside the lakes, and the various steelworks are supplied from these piles all the year round.

Many of the steelworks are built close to the dumps of

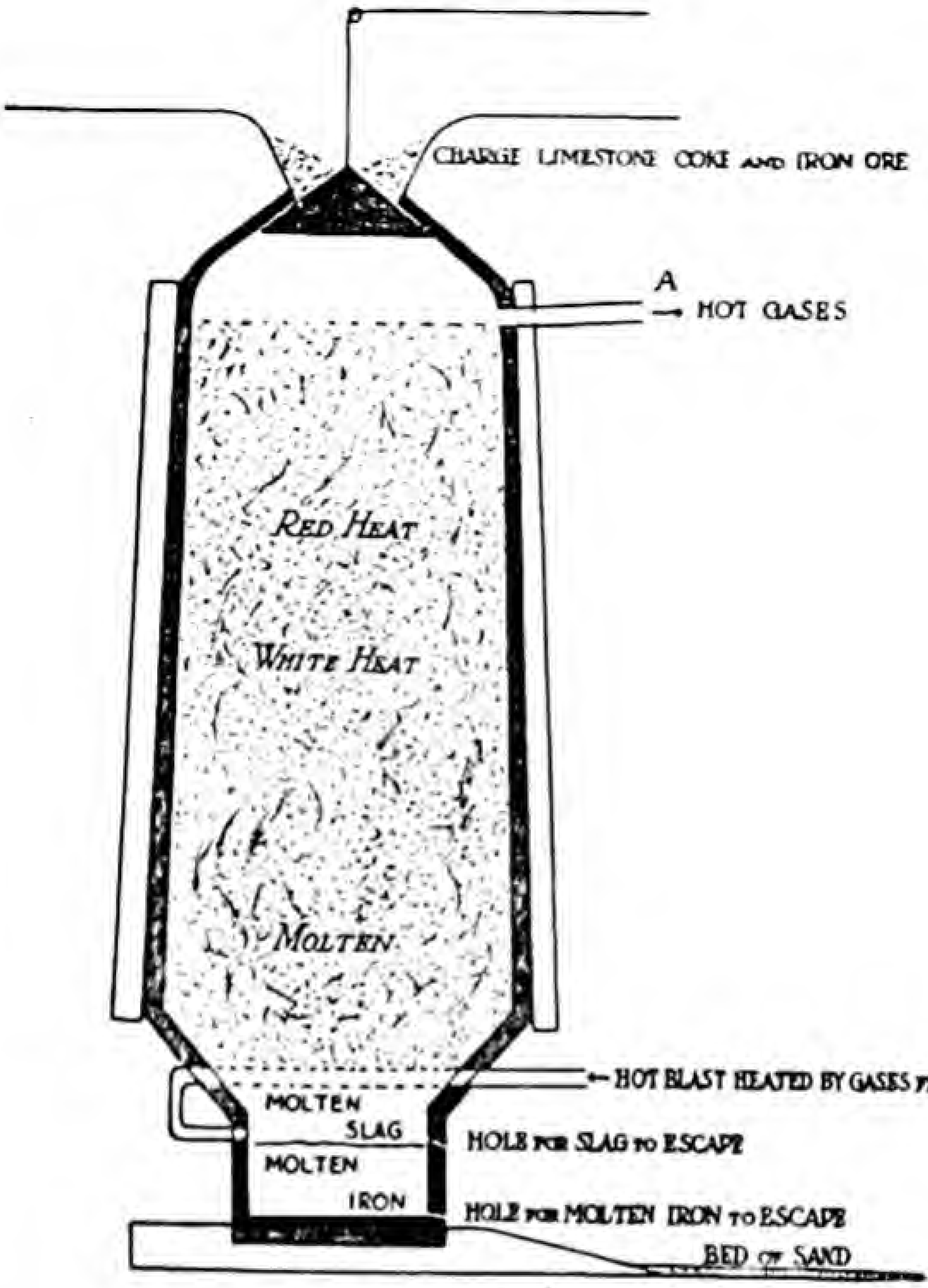
ore, and coke brought by railway is also stored near by. Another material needed for the manufacture of steel is limestone, and supplies of this are also maintained near the steelworks.

Centuries ago blacksmiths made iron by burning ironstone with charcoal made from wood. The red-hot lump found at the bottom of the fire was then hammered again and again. When the lump cooled it was reheated, until at last a piece of iron was the result. This iron was not very pure, but it was better than bronze for weapons. Later on the armourers found that by making the fire very hot, and using more care, a harder substance called steel could be made. The armourers of Damascus, Toledo, and Milan were famous during the Middle Ages.

The modern manufacture of steel is very complicated. The three materials—ore, coke, and limestone—are heated together in a large tower-like blast furnace, through which a blast of hot air is continually being forced. The furnace is loaded by machinery, while near by are tall chimney-like " stoves " in which the gas is heated. The furnace is always kept full and never goes out. It is working day and night.

From time to time the molten iron, which has trickled to the bottom of the furnace, is drawn off. It is collected in steel trucks lined with fireclay, and these are then hauled away to other furnaces to be made into steel.

There are two ways of making steel. One was accidentally discovered by Sir Henry Bessemer, an English engineer who was trying to purify molten iron by blowing air through it. To his surprise he found that the molten iron, instead of getting cold, and freezing, remained very hot and turned into steel. It took many years to invent a furnace in which this could be done easily, and the apparatus now used is called a " converter."



HOW A BLAST FURNACE WORKS.

The furnace is a tower of fire-brick about 100 feet high, cased in steel. The charge, which consists of coke, iron ore, and limestone, is fed in at the top from a mechanical loader. The top of the furnace is closed by a double cone, which allows the charge to pass without the gas inside escaping. At the foot of the furnace is a ring of water-cooled nozzles like a gigantic gas-ring. A hot blast is forced through these into the furnace. This helps to keep up the heat of the furnace. The used gases come out at the top of the furnace by a large pipe which leads to the stoves where their heat is used to heat the blast. The molten iron trickles to the bottom of the furnace, and the impurities collect above it as molten slag. The iron is run off from time to time into trucks lined with fireclay, and taken to the converters to be made into steel (see page 187). Sometimes the iron is run straight on to the sandy floor of the moulding shed.

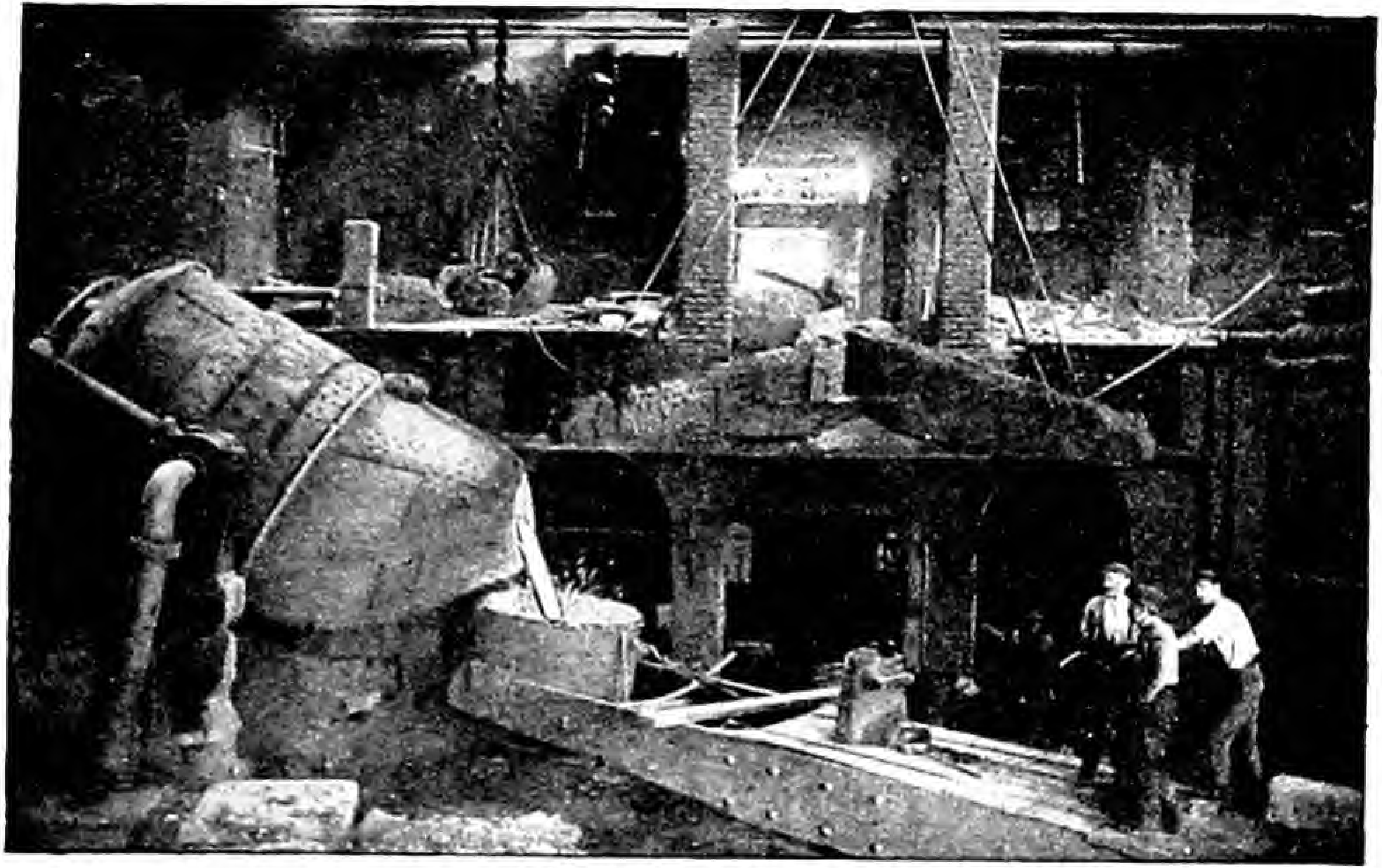
The trucks or "ladles" of molten iron are poured into a large bottle-shaped converter, through which a blast of hot air is blown so that the air bubbles through the molten metal. All the impurities are burned away and the iron is changed into steel within a few minutes. Before the steel has finished "boiling" a small amount of another mineral called manganese is added. This helps to make the steel very hard and tough.

When the process is complete the steel is poured into moulds and allowed to cool into solid lumps or ingots. These are then carried, while still hot, to the rolling mills to be squeezed or rolled into various shapes.

The Bessemer process is very cheap and quick, and is used mainly in America. Soon after it was invented another British engineer, Sir William Siemens, discovered a fresh and even better way of making steel. This was by heating the molten iron in a wide shallow furnace and passing hot air and gas over the molten metal. From time to time broken pieces of other steel are added. The furnace is lined with a special kind of fireclay which helps to change the iron into steel.

This "open hearth" process, as it is called, is much more difficult and takes many hours, but the steel is much more valuable to the engineer, for it is strong and tough. It can be made from scrap iron and waste material, and so the steel-works need not be near a blast furnace. It is also possible to add various other minerals to the iron to make special kinds of steel for special purposes, so that nowadays by far the most steel is made in this way.

Bessemer steel is used for such things as pipes, wires, bars, and sheets of steel. On the other hand "open hearth" steel is used for boiler or ship plates, for girders and beams, for railway lines and for machinery.



A BESSEMER CONVERTER.

Molten iron is changed into steel inside a huge bottle-shaped pot through which hot air can be blown. This burns away the impurities left in the iron from the smelting, and changes it into white-hot steel, which is poured out into giant crucibles, as shown.

Of the special kinds of steel the most famous are stainless steel, which will not rust and can therefore be used for bridges and other structures exposed to the weather, and nickel steel, which is intensely hard and is used for making armour plate for battleships.

About one-half of the steel of the world is made on the Pennsylvania coalfield. Pittsburgh, the chief steel-making centre, is a large city built where several rivers meet, so that coal and coke can be brought quite easily. It is sur-

STEEL

rounded by a ring of steel-making towns, to which the ore is brought by railways and canals from Lake Erie.

In Europe the chief steel-making centres, outside Britain, are in Germany, France, and Belgium. The ore is found in Lorraine, where these three countries meet. Here there are great layers of iron ore below the surface of the ground. The Lorraine ore does not contain so much iron as the Lake Superior beds, but it is more easily smelted. The chief mining centres are Longwy, near the Belgian border, Briey, and Nancy. From these places the ore is sent by train to the big steelworks in Germany, France, and Belgium.

The German steelworks are mainly on the Ruhr, or Westphalian coalfield. This is the basin of a small river, the Ruhr, which is a tributary of the Rhine. There is abundant coal for coking, and so this region has become the second greatest smelting area in the world. Essen is the most important of the steel towns, while not far away are Gelsenkirchen, Bochum, and Dortmund. There are also several other large factory cities such as Barmen, Elberfeld, Krefeld, and Aix-la-Chapelle, which are mainly engaged in making textiles.

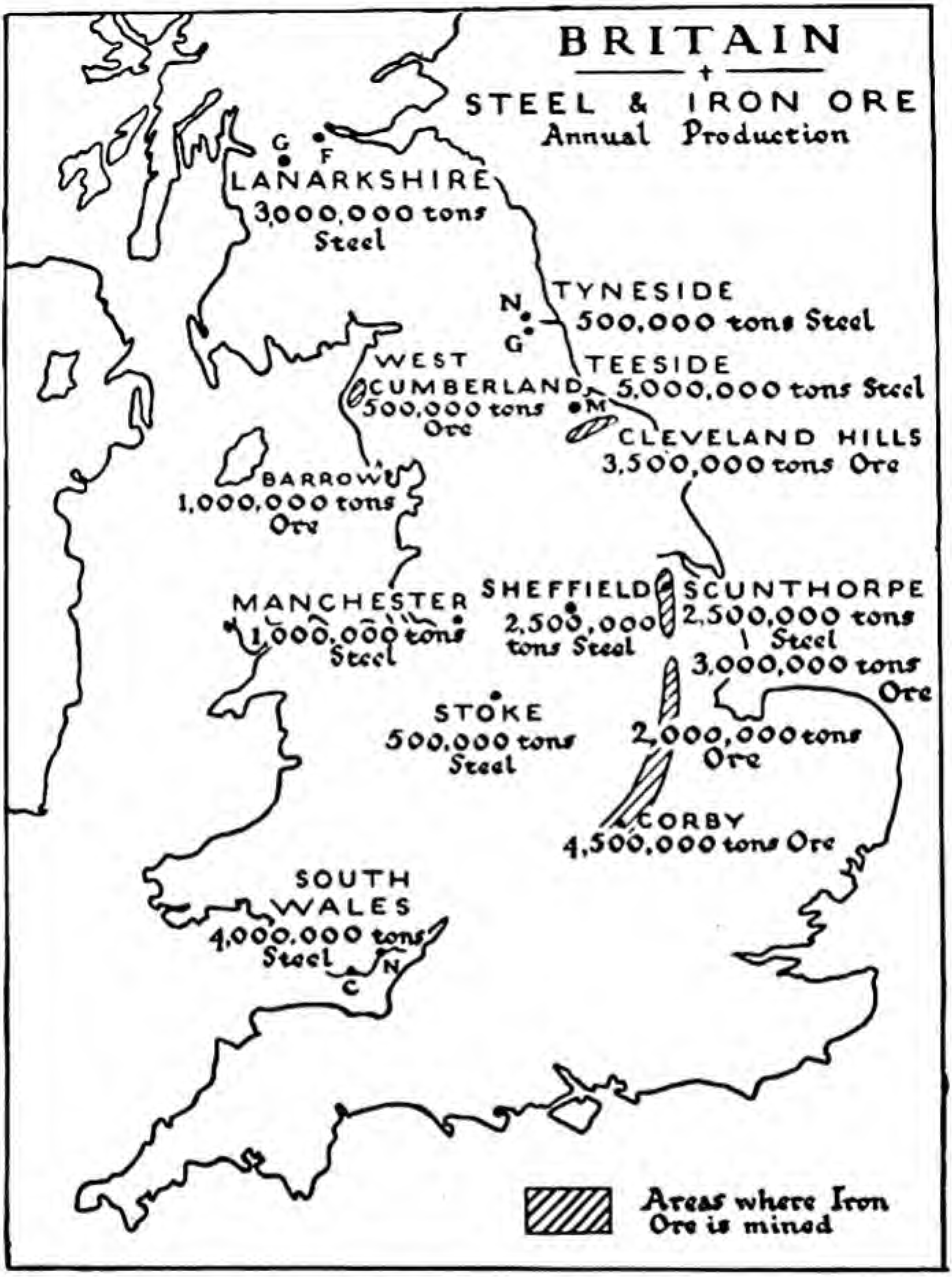
Most of these towns are on the far side of the river Rhine, away from the ironfields, but the river is crossed by railways at Cologne, Düsseldorf, and Duisburg, so that these have become great bridge towns. In addition to using the iron ores from Lorraine, the great smelting-works on the Ruhr also use other metallic ores from all over the world. These are brought by ship up the Rhine to the bridge towns, and so these are also large river ports.

The chief ores which are imported into the Ruhr are copper from the Congo, zinc from Australia, and special kinds of iron ore from Spain and Sweden.

In Belgium the largest steel-making centres are along the Meuse valley, from Charleroi to Liége, where the coal is also very good for coking. Seraing, just outside Liége, is an important steel town.

These cities suffered seriously during the World War of 1914–18, and with the aid of the compensation paid by Germany, new and up-to-date steelworks were constructed, not only there, but in another district called the Campine near the great seaport of Antwerp. This district again suffered severely in the Second World War.

The changes that went on in the Campine showed how man can rapidly change the surface of the earth. Instead



STEEL AND IRON ORE IN BRITAIN.

Notice that the four great steel areas in Britain, in order of output, are Teesside, South Wales, Lanarkshire, and Sheffield. The most important ore-mining districts are along the oolitic ridge from Corby, near Northampton, to Scunthorpe in North Lincolnshire.

of meadows and fields cultivated by peasants, there are now many coalpits—not the dirty, smoky collieries of forty years ago, but clean and almost smokeless. The power is provided by electricity and gas. Beside the coalpits are the great coking works and the blast furnaces, which now consume most of their own smoke and fumes.

Instead of the workers having to live in crowded, unhealthy cities, there are pleasant villages of new houses each with its garden, while buses take the people to and from their work.

What is being done in the Campine is also happening in other places, and new factory "garden cities" are being built in more healthy conditions both in Britain and in other countries.

In Britain the supplies of iron ore are found largely in a broad belt which extends from the mouth of the Tees southward into Northamptonshire and the Midlands. The most important district where the ore is mined is along the slopes and valleys of the Cleveland Hills in North Yorkshire.

Here the iron ore is of very good quality, and is found on the surface of the ground, so that it can be quarried in large open workings. As the ore-stone is removed it is loaded into trucks on small lines that feed the main railway at the end of the valleys. Much of the iron ore goes to Middlesbrough, which is the largest steel-making town in Britain.

The coking coal for the furnaces comes from the Northumberland coalfield, which extends along the eastern side of the Pennines, near the sea. The wide tidal estuary of the Tees enables the steel products of Middlesbrough to be exported to other parts of the world.

Another important tidal opening is that of the Tyne. This enables large ships to reach Newcastle, twelve miles inland, and from there to the sea the river is lined with ship-

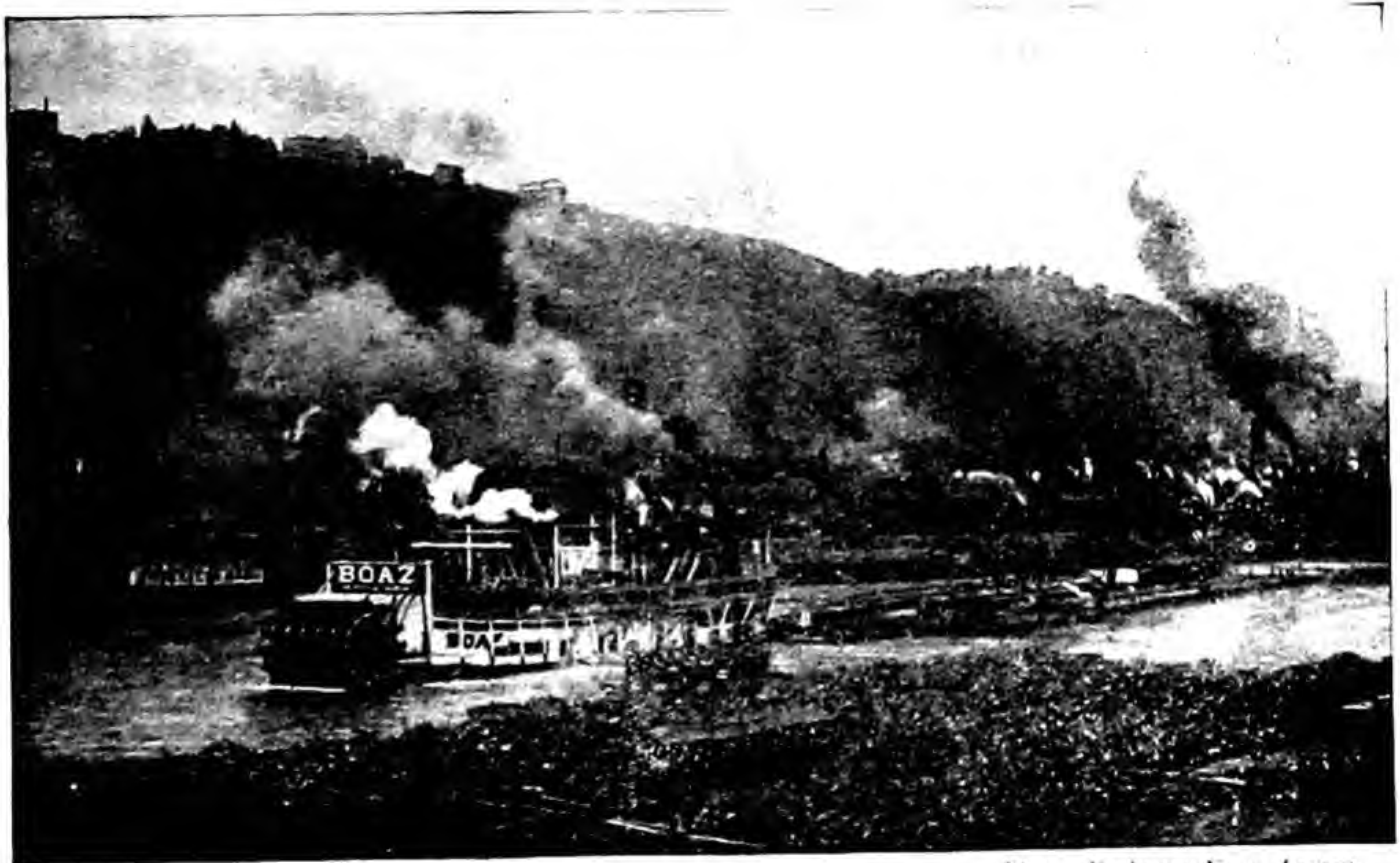


Photo. Exclusive News Agency.

PITTSBURGH, WITH COAL BARGES AND STEELWORKS.

yards, steelworks, and engineering works. There are also large "staithes" or piers for loading coal, which is sent to other countries.

Steel is also made on most of the other coalfields of Britain, the ores being obtained from other districts or imported.

The Black Country, as the great smelting area around Birmingham used to be called, now obtains most of its iron ore from Northamptonshire. This region makes anything from a pin to a steam-engine, and also all kinds of brass and copper goods.

South Yorkshire, along the Don Valley, makes special kinds of steel for tools, armour plate, and guns. In peace time the ore for these special steels is brought from Sweden, but the big steelworks of Sheffield also use ready-made steel from Germany and U.S.A. This steel is re-smelted and treated in various ways to give it the special qualities that are desired.

Scotland has a large steel-making area round Glasgow and along the river Clyde, while in South Wales there are big blast furnaces in the Cardiff and Newport district.

In addition to these, many large engineering firms and railway companies have their own steelworks, and these are often far from the coalfields, so that the needed coke and ore have to be brought by rail. One of the largest steelworks in the South of England is on the north side of the Thames estuary at Dagenham. This supplies the Ford motor-car factories.

The Ford furnaces turn out one hundred tons of steel a day and work mainly on scrap iron, using the open-hearth process. The building of this steelworks is another example of how the world is changing, and how, nowadays, it is no longer necessary to have factories near the coalfields. They

are now built where there is more room, where land is cheaper, and where they are in a better position for selling the goods. Only the " heavy industries " of iron and steel remain near the coalfields.

Although the greatest steel-making regions of the world are in U.S.A. and Western Europe, the production of steel is so important that other countries such as Russia, Japan, and China are now producing steel for themselves.

Russia covers a very large part of the earth's surface, and possesses supplies of almost every material used in everyday life. The Russian people are therefore doing their best to utilize the resources of their country, and to make everything that they need for themselves. The richest iron ores are found in the Ukraine, to the west of the river Dnieper, and about one hundred miles from the sea at Krivoi Rog. The coke for smelting is obtained from the Donetz coalfield one hundred and fifty miles to the east.

The Krivoi Rog district produces three-quarters of the cast-iron of Russia. Large steelworks are also in operation.

Japan is another country which needs steel in large quantities, both for machinery, ships, and buildings. There is, however, very little iron ore available in Japan, and so the Japanese have to import it from Manchukuo, where there is a very rich area of ore. It was partly the need for making their supplies of steel secure that led Japan to establish the new state of Manchukuo, which, a few years ago, belonged to China.

The Manchukuo supplies of iron ore are in the Liaotung Peninsula in the south, and are at least ten times as great as the supplies in Japan itself.

The ironfields of China are mainly along the valley of the Yangtze River, near the great city of Hankow. The blast furnaces are at Hanyang, a twin city of Hankow on

the other side of the river. There are also valuable fields of iron ore in Northern China in the province of Shansi. Practically all the steelworks and blast furnaces in China are controlled by Japan.

There are very few steelworks in the southern hemisphere. They are almost entirely in Australia in the Hunter Valley coalfield in New South Wales, to the north of Sydney. Australia is such a long way from the rest of the world that it is very important for her to have her own supplies of steel.

COPPER

While iron and steel are the most important metals in use to-day, there are several others which are needed by the modern world. One of these is copper, which is of value because it is a good conductor of electricity. Huge quantities of copper are needed to make the machinery, wires, cables, and switches used in the production and distribution of electricity.

The copper is found as an ore, but, unlike iron ore, it is not easy to smelt. A great deal of the copper ore of the world is transported thousands of miles to be smelted. The largest copper-producing country in the world is the United States, which supplies about one-fifth of the world's supplies. Most of this copper is mined either near Lake Superior or in the Rocky Mountains.

Canada also produces large quantities, mainly from the district to the north of the Great Lakes near Sudbury.

Chile, in South America, is the second largest copper-producing country of the world. The mining areas are in Northern Chile high up in the Andes, and the metal is exported from Iquique and Tocopilla.

Africa possesses very large deposits of copper ore, mainly

in the district between the south-east part of the Congo and Northern Rhodesia. The development of the copper mines has enabled railways to be completed to the coast. One of these runs to Benguella, a Portuguese town on the Atlantic coast, and carries most of the ore from the Congo. The output of the Rhodesian mines travels partly along this route, but a good deal is sent south and east to Beira, another Portuguese port but on the Indian Ocean. Most of this

COPPER

African ore is sent to Belgium, South Wales, or the Ruhr to be smelted.

Australia possesses valuable supplies of copper in various parts of the continent. The richest copper mines are at Cobar, in the middle-west of New South Wales. A railway has been constructed to link up with Sydney, and most of the ore is sent to Lithgow, near Sydney, to be smelted, as coal is available there. Copper is also found, with other minerals, in Western Australia and in Queensland.

Japan is another of the great copper-producing countries of the world. This metal is, indeed, the most important of all the Japanese minerals. It is found in many districts, but

the chief mining areas are in the northern half of Honshiu, the main island of Japan.

In Britain the chief copper-smelting area is in South Wales, round Swansea and Llanelly. The ores are imported from Canada, Australia, and Spain.

LEAD

Another very useful metal is lead, which is not affected by the weather, or by being buried in the ground. It can therefore be used for roofs, gutters, and pipes, for lining cisterns and for covering-in woodwork or metal work which may be exposed to the weather. In addition, vast quantities of paint are prepared from lead. The chief material in such paint is what is called white lead, a compound which is ground up with oil and colouring matter to make lead paint. Such paint also possesses the preserving powers of lead.

The chief lead-producing countries of the world are the United States, Australia, Mexico, and Canada. Half the lead of the world comes from North America.

In the United States the chief lead-producing area is in a group of hills called the Ozark Highlands, almost in the centre of the Great Plains, and about 300 miles west of the Mississippi. The ores contain zinc, which is also smelted. The remainder of the lead mines are in the central part of the Rockies. In Canada the chief lead-producing district is in British Columbia, along the Kootenay River.

Australian lead is found, with zinc, at Broken Hill, a rich mining area in the extreme west of New South Wales, on the borders of South Australia. The ores found in this district are a mixture of tin, silver, lead, and zinc. When the mines were first opened, tin was the most important

metal produced. Then, as the mines were deepened, silver became important. Lower down, lead ores were reached, and to-day, at about 300–400 feet below the surface, zinc is mined.

Thus Broken Hill began as a *tin* mine, became a *silver* mine, then a *lead* mine, and now is a *zinc* mine.

OTHER METALS

Zinc is very much used for coating or "galvanizing" iron, thus protecting it from the action of air and weather, and preventing rust. Galvanized iron is a very cheap and useful building and roofing material, and is used all over the world, especially in the Tropics, where woodwork is attacked by ants and other insects. Pipes, wires, and other fittings are also galvanized.

Both copper and zinc are smelted by the aid of electricity. In some districts the smelting-works are near the mines. In others, as at Broken Hill, it is cheaper to partially smelt the ores near the mines and send the impure metals elsewhere to be refined. A large quantity of the Broken Hill "concentrates," as they are termed, are refined in Tasmania, where there is abundant water-power for producing electricity. The concentrates are first sent to Adelaide by rail or to Port Pirie on Spencer Gulf. From there they are shipped to Hobart in Tasmania, or sent to South Wales ports for smelting.

Tin is another metal which owes its value partly to its protecting qualities. It is used for coating thin sheets of iron as "tin plate," which is used for cans and other containers. It is also used to mix with other metals to make what are called alloys. Some of these alloys are very useful. Tin and copper mixed together make bronze and brass.

Photo: Malayan Information Agency.

A TIN-DREDGE, MALAYA.

Where the deposits of ore are soft and near the surface, as are the tin deposits in Malaya, mining is usually carried on by dredging. The huge machine shown above floats on the surface of an artificial lake, which it digs for itself as it goes along. At the front (on the right) is an endless chain of buckets which digs out the ore, to a depth of as much as 120 feet. The ore is then washed free of mud and stones, which are tipped out at the back of the dredge (on the left). Thus the dredge slowly eats its way forward and fills up the lake behind it. The floats in the foreground carry the electric cable which supplies power for the machinery in the dredge. The tin ore will be sent to Singapore for smelting. This method is also used in mining for gold.

Most of the tin of the world is mined by dredging. The ore is found in the form of soft ground which can be dug out. A large hole is first dug and flooded with water to make an artificial lake. On this a large piece of machinery called a dredge is floated. The dredge is almost like a floating factory. At one end is an endless chain of steel buckets, which dig up the earth from the bottom of the lake. As the wet sludge is brought up, it is emptied into long troughs over which water is flowing. The water washes away the

mud and leaves the heavy tin ore behind in the bottom of the trough.

From time to time the tin ore is removed, while the mud from which it has been taken is piled up behind the dredge. Thus the dredge slowly eats its way forward, digging up the ground in front of it and filling up the lake behind it. Some of these dredges are very large and work to a depth of 120 feet.

The districts where tin dredging is carried on are in the Malay Peninsula, the East Indies, Siam, and Nigeria, in West Africa. The Malayan and East Indian ores are smelted near Singapore. These huge smelting-works handle over half the tin of the world.

Another important tin-producing country is Bolivia, a plateau high up in the Andes. Here the tin is mined like other metals. South-east China also produces a good deal of tin.

Another very important metal which is being used increasingly to-day is aluminium. This has two valuable properties: it is very light, and it is a good conductor of electricity. Further, it does not rust easily.

Aluminium is used in aeroplane construction. The metal itself is not very strong, but various alloys have been discovered which are almost as strong as steel, and are nearly as light as aluminium itself. The metal is also used extensively in motor engines, and it can be cast, pressed, or stamped into all kinds of shapes, including pipes, sheets, and fittings. Aluminium kettles and saucepans are now replacing enamelware, since it does not chip and is easily kept clean.

Another important use for aluminium is in the electrical industry, and most of the large overhead cables which carry electricity from one district to another are now made of aluminium, with a strand of steel wire in the centre to give the necessary strength.

Aluminium is smelted from a kind of clay called bauxite. Most of the important European nations have supplies of bauxite, but the world's largest supplies come from the United States. The smelting is carried on by electricity, and so the important aluminium works are all near big electrical power stations.

In Britain the largest of these is in Scotland, near Ben Nevis. The water needed for the power station is taken from a lake through pipes and tunnels which actually pass underneath the mountain.

There are many other useful metals, most of which are produced in small quantities and are used for mixing with other metals to give them special qualities. Others such as chromium or nickel are also used for "plating" metal articles to give them a bright finish. Some metals such as tungsten are used for the filaments of electric lamps and radiators.

Thus man is not only able to obtain food from the animals and plants on the surface of the earth, but he is able to obtain all kinds of useful materials from the rocks of the earth itself.

CHAPTER XIV

POWER

THE present day is outstandingly the day of power—the day of the machine. We eat, live, and sleep in a world dominated by machinery. The modern workers eat a breakfast that is cooked with heat supplied in the form of gas or electricity from a large power station. They catch a bus at the door, or travel in a car propelled by petrol- or oil-driven machinery to a railway station where they enter a train moved by steam or electricity. Another bus carries them to the factory or office, where they may be carried up to their work in a power-driven lift.

Not only has the machine conquered the factory but it has even invaded the office. Practically all letters and documents are typed, long columns of figures are added by other machines, and many other ingenious machines help to do the work of the day. Machinery is even appearing in the home, and the vacuum cleaner, floor polisher, washer, and mangle are now all driven by electricity. It is also possible to have dishes washed and dried by machinery.

Even the amusements of man are now largely controlled by machinery. Every evening millions of people visit cinemas, where they watch probable and improbable scenes portrayed by machinery on a screen, to the accompaniment of speech and music produced by more machinery. Others may listen to another music-making machine, the gramo-

Photo: Photo. Pub. Ltd.

PRIMITIVE POWER.

In the East the ox has been used for centuries to provide power for simple machinery. Here an Egyptian farmer is raising water for irrigating his fields by a crude water-wheel worked by an ox. The machinery is home-made, and is entirely of wood. It is rough, it creaks and squeaks, but it works, and seldom gives any trouble.

phone, while the light and warmth about them is also supplied from the big power stations.

Nor does this use of machines seem to grow less. When the first machines were made, a century and a half ago, they were not wanted by the folk whose work they were going to do, and the hand workers, with sledge-hammer and torch, did their best to destroy them—a hopeless effort. To-day everyone makes use of machinery, and even the baby in the nursery plays with ingenious mechanical imitations of the things that are afterwards going to control his life.

For all these machines we need Power—some means of making the wheels go round. The very first machines that

were used by men or women were driven by hand. Probably the very first machine ever invented—that of the mill for grinding corn—was invented by a woman who had grown tired of pounding it in a mortar. Then the mill was made large enough for the stones to be turned by oxen, or by slaves. In those days human labour was cheap.

As time went on certain other machines were invented, especially for raising water from wells or rivers to supply the thirsty ground with water for the fruit trees or crops. Thousands of these age-old machines are still in use all over the East, though the more enterprising farmer now puts in a motor pump and sells water to his neighbours at a profit.

The oldest power-driven machinery was worked by water—the old-fashioned water-wheel—and when machines were first invented for making cloth they were also driven by water power. The very first factories in England were built along the smiling valleys of the Pennines, where the fast-flowing streams came down from the hills. Many of these old mills, now deserted and derelict, are still to be seen.

Water, however, had to give place to steam, and this depended upon coal, which was used as a fuel to heat the boilers. The ordinary steam-engine, in spite of the cleverness with which its various parts are arranged, is really a very clumsy piece of machinery, and is now rapidly disappearing. It is very wasteful, too, for only one-fifth of the power available in the coal can be used. With many steam-engines the power obtained is even less than that.

In the days when steam power was at its height the coal was sent by rail or canal from the colliery to the factory, where it was used to boil the water to obtain the steam. To send the coal over long distances increased the expense, and so it was necessary for the factories to be built near the

Photo: C.P.R.

HARNESSING NATURE TO PROVIDE POWER.

A view of one of the many big hydro-electric power stations which are being developed on the outskirts of civilization in North-eastern Canada. This is at Grand'Mere, twenty miles from Three Rivers on the St. Lawrence River, at the point where the Maurice River leaves the plateau for the lowlands. It is typical of the way in which the wilderness is being conquered. After a railroad has been run through the forest to a spot chosen by the engineers, a great dam and power station is constructed. Farms begin to spring up in the clearings as the forest is cut back by the lumber companies. The power enables industries to be established, and soon a thriving township stands where before there was only forest and river.

coalpits. Hence the crowded, smoky factory towns of Northern England and Central Scotland came into existence.

From the engine-house of each factory long lines of revolving shafting and swiftly moving belts carried the power to the machines. When the workman wished to stop a machine he had to slide the moving belt off the machine, but the engine still kept at work. The long lines of shafting

and the belts had to be carefully guarded to prevent the worker from being caught by them, for many a life has been lost in that way.

This old-fashioned system is still in use in some factories where the owners have not had the money or the inclination to make a change, but no modern factories are run on these lines. Steam has given place to electricity.

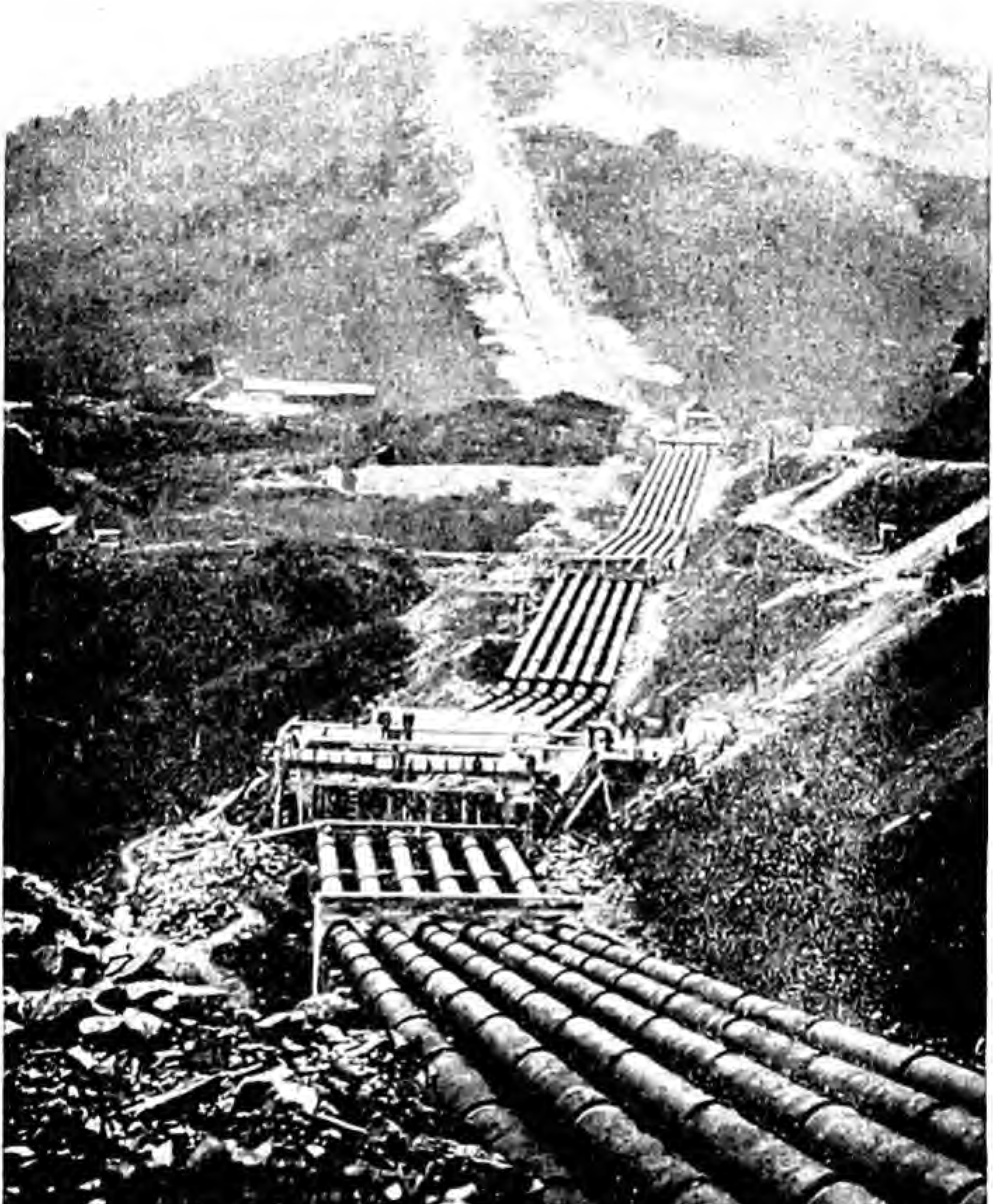
ELECTRICITY

Electric power is cheap, simple, silent, and safe. It can be produced in large power stations and sent along a cable for hundreds of miles if necessary. There is no smoke or smell, and practically no noise. The factories can be built in pleasant surroundings in the heart of the country if need be. The workers need no longer be crowded together, for it is not necessary for two factories to be close together. The only matter which the factory owners have to consider is transport. Roads or railways are needed to bring the raw materials and to carry away the finished goods. While many factories are built beside a railway, others make use of roads, and may be a mile or more from the railway.

Electricity is a convenient form of power, but it has to be produced by machinery which itself needs to be driven by either water or steam. The machines which produce this power are called turbines, and are similar to rapidly revolving fans. The steam or water presses against the blades of these "fans," causing them to spin round.

Power stations which use water for the production of electricity are usually called hydro-electric power stations. The water needs to be at considerable pressure, so that hydro-electric stations are either in mountainous districts or situated near falls or rapids on a river.

Mountain power stations usually make use of a lake as



A WATER-POWER LINE IN SCOTLAND.

These lines of pipes draw water from a Highland loch and carry it down the mountainside to the great power station of the aluminium works at Kinlochleven, on the south side of Ben Nevis. This is at the head of a deep-water loch and can be reached by ocean-going vessels.

a reservoir. A dam is built across the lower end of the lake to control the level of the water, and large pipes, several feet in diameter, take the water to the power station, which is situated at a much lower level. The lower the power station is below the lake the greater is the pressure or "head" of water, and the more the power obtained.

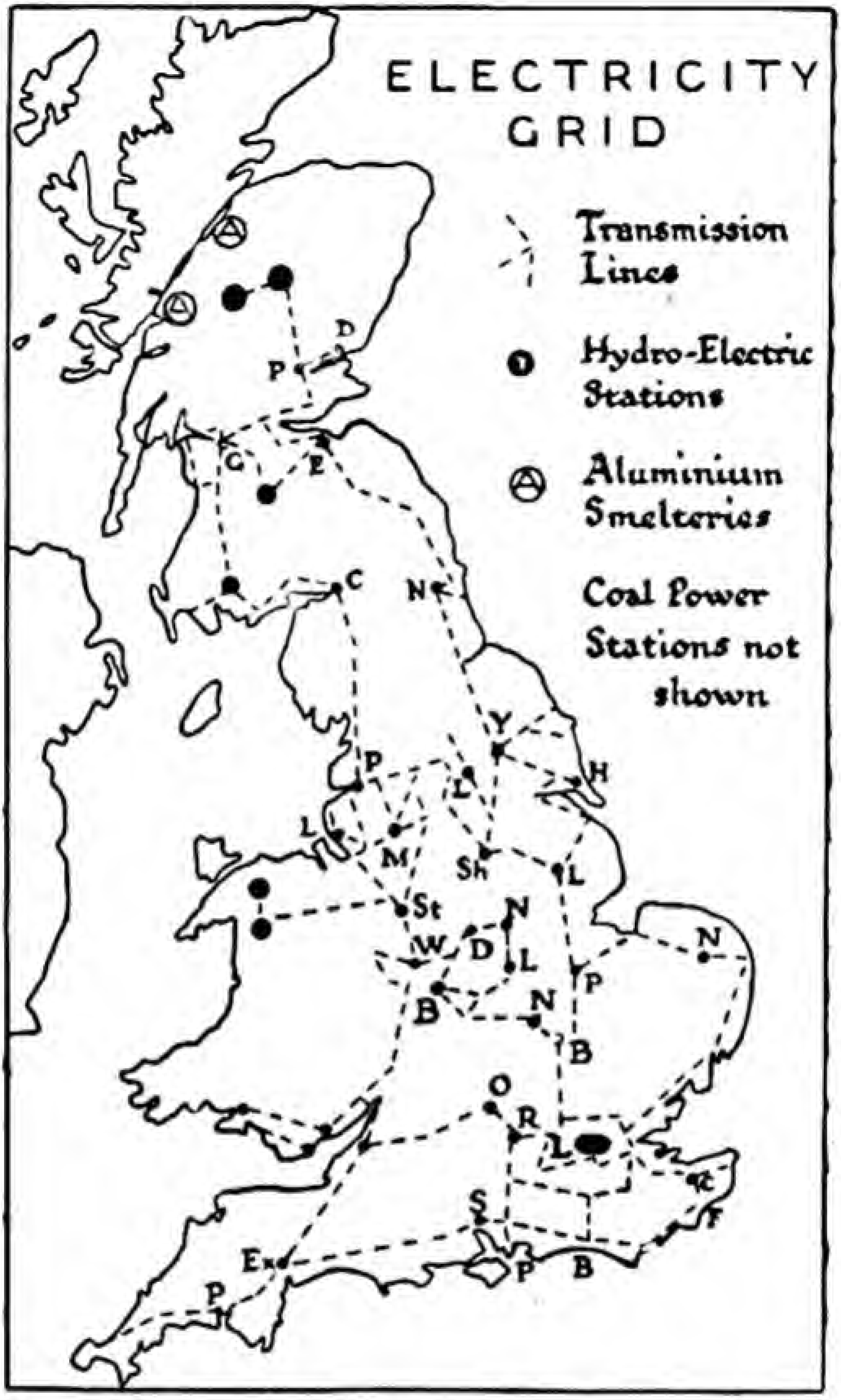
The pipe-lines usually descend the mountainside, the water flows through the turbines and then rejoins the river or stream below the power station.

Where the power station is near a waterfall much the same method is used. A large pool or reservoir is constructed beside the river above the falls. The pipe-lines are taken from this to the power station at the lower level.

From the power station the electricity is distributed by overhead cables, slung from steel pylons. These carry it to the factories or cities where it is needed. Nowadays all the big industrial nations are constructing these large power stations, and where water-power is not available steam is used. The boilers in a modern steam-power station are fired by oil or powdered coal. The old-fashioned method of shovelling the coal into furnaces beneath the boilers is now out of date, for it is very wasteful and smoky, besides being very hard work to do properly. Where these coal-fired boilers are still in use, the coal is fed into the furnaces by machinery.

Nowadays, however, powdered coal is used. This is crushed to a very fine powder, which is then blown through nozzles just like gas. The jets of powdered coal and air burn with a very hot flame, and the coal burns completely away, with practically no ash. Only certain kinds of coal are suitable for burning in this way. Soft or tarry coal is of no use, for the jets would soon become gummed up. Anthracite therefore is used.

These large power stations are practically smokeless and



THE ELECTRICITY GRID IN BRITAIN.

This map shows the main power lines controlled by the Electricity Commission. By means of overhead cables, the power is carried to the farm, town, or factory. The two aluminium smelteries in the Highlands are Foyers, near Loch Ness, and Lochaber, near Fort William. These works use more electricity in a week than a large city does in a year. The Lochaber power station generates 120,000 horse-power.

there are no injurious fumes, so they are very suited for building in or near large cities. While electricity can be distributed by cables over long distances, there is always the chance that in times of storm the overhead cables may be broken. For this reason large cities, where perhaps millions of people depend upon electricity for light and power, have their own power stations in addition to those at a distance.

Nowadays a country is covered by a network of cables or "grid," which links up the various power stations. Then, if for some reason the supply fails at one station, the current can be supplied from other stations.

In England all the big power stations are steam- or oil-driven, but there are one or two hydro-electric stations for aluminium smelting in Scotland and North Wales. Ireland has a large hydro-electric station at Lough Derg on the Shannon. This is large enough to supply power for the whole of Ireland.

Mountainous countries such as Switzerland and Italy have many hydro-electric stations, and there are several in Germany, as well as others driven by steam or oil. Russia has a large hydro-electric station in the Ukraine, on the falls of the river Dnieper at Dnepropetrovsk. In North America the largest power stations are all hydro-electric. Those at the Niagara Falls are the most powerful. Eastern Canada possesses several more. In New England, the factory land of U.S.A., the whole of the power is hydro-electric.

The methods which have proved so successful in Europe and North America are now being followed in other continents, particularly in South America and Australia. Even India is beginning to use electricity. Engineers are also working upon plans to harness the tides, and so use the power developed by the attraction of the moon. If this succeeds, big tidal-electric power stations may be built at suitable points.

COAL

Even with this increasing use of electricity, coal is still important. It is needed in huge quantities for the making of steel, it is used in modern power stations in the form of powdered fuel, and it is still the most important fuel used by ships.

The coal supplies of the world are almost entirely in the Northern Hemisphere, in Europe and North America. The southern continents possess very little coal, and must therefore be more dependent upon water-power or oil.

The coal is found in "seams" or layers, which are from a few inches to several feet thick. The seams are usually reached by sinking vertical "shafts," though on some coal-fields it is possible to reach the coal by galleries driven into the side of the hills. In a very few places the coal is near enough to the surface to be quarried.

In every coal mine there are two shafts, the main or down-cast shaft, used by the workers and by which the coal reaches the surface, and the reserve or up-shaft, which is normally sealed at the top. A short side-shaft near the top of the up-cast shaft leads to a powerful suction-fan which draws the foul air out of the mine. By a clever arrangement of ventilating gates the fresh air enters the mine only by the down-cast shaft, and circulates right through the workings.

Access to the underground workings is by means of a cage, which is lowered down the main shaft by a steel rope.

Powerful steam or electric winding-engines are used, and the rope passes from these over the large wheel above the pit-head. The steel cable is examined very carefully each day before use, since the safety of the men depends upon this slender link with the surface.

The cage is usually large enough to hold four tubs or

Photo: Aerofilms.

A MODERN COLLIERY IN BRITAIN.

Broadsworth Main Colliery, near Doncaster, gives an idea of the extent of a modern colliery. Leading from the pit-head are covered runways, along which the loaded tubs of coal reach the washing and screening plant in the foreground. Notice the many lines of railway sidings; one of the most important jobs at the surface is to see that trains of empty trucks are continuously coming in, and that the loaded trains are made up and dispatched promptly. This goes on night and day. Beyond the pit-head is the winding gear and power station which generates the electricity used in the pit as well as for the surface machinery. In the distance is the colliery village where the pit-workers live.

trucks, and two cages work in the one shaft. When one cage is ascending the other is descending. The men also use the cages for going to and from their work beneath the ground.

From the foot of the down-cast shaft runs the main haulage road, a wide arched tunnel whose roof is supported by curved steel girders, and along which is a double line of

rails by means of which the tubs of coal are hauled to the shaft. A smaller tunnel or "travelling road," running parallel with this haulage road, is used by the pitmen in going to and from their work. This also acts as a reserve road when repairs are needed or the main haulage road is blocked. Every mine is divided into numbered "districts," each in the charge of a "deputy" or "fireman," who is responsible for the safety of the men in his district. There may be half a dozen districts in a large mine.

The method of coal-getting known as the long-wall system is the most common in Britain. The coal face is worked in a long straight line or "wall" along the seam. If the seam is four feet thick it is necessary, in places, to cut or "rip" out the shale or rock for a couple of feet or more above the seam. This rock is then carefully built into thick walls lining the "gates" or roads leading from the face. This "packing" is done by special workmen, and has to be done very carefully so that the "packs" can take the pressure of the rocks above.

Along the coal face runs a "face-conveyor," which carries the coal along and empties it on to the "gate-conveyor" running back from the face to the pony road. Ventilating doors close these gates, so that the fresh air may pass right along the coal face. Behind the gates runs a pony-or haulage-road along which the coal is hauled in steel tubs, each holding about 10 cwt.

There is a popular, but foolish, idea that the pit ponies, or, more properly, pit horses, are blind, and that their life is a very hard one. This is very far from the truth, for under the many regulations which govern work in the coal mines, the pit horse is as carefully protected as the men with whom he works. No horse is allowed in a pit until it is four years old, and then only after it has been passed as sound by a "vet."

An unsound animal would be of no use in a mine, for the efficient haulage of the coal is as important as the actual cutting. Only strong healthy animals are used, and it pays the colliery owners to look after them well. Good food is provided, and clean, well-lighted and ventilated stables underground. The pit horses are therefore as well kept or even better than many of those above ground.

They are very intelligent and know exactly what to do without being told. Each horse pulls a train of ten loaded tubs coupled together by chains. The pony roads usually run from the gates to the main haulage road. The tubs are then clipped to an endless travelling cable, which pulls them along the main haulage road to the up-cast shaft. The air passing through the district is drawn off along a ventilation road which leads direct to the up-cast shaft. The whole of the workings are linked by telephone to the surface. There are also underground stables and stores, besides ambulance stations at convenient points. Above ground is the machinery and gear for winding, for supplying electric power to the machinery and pumps in the mine, and for screening, loading, and washing the coal.

The cages deliver the tubs at a higher level than the ground, and the rails slope gently down the " bank," as it is called, so that the full tubs run down by their own weight.

First they pass a weighbridge, where the weight is noted, and then they pass to mechanical " tipplers," which empty the coal into a chute below. This delivers the coal to the screens, which sort it out into various sizes and deliver it to the waiting railway trucks.

Meanwhile the empty tubs are hauled up by a " creeper chain " to the top of the bank and run down to the shaft, for the " banksman " to send them down again underground.

A coal miner's work is very dangerous, not only to the

worker himself, from a fall of rock or from deadly gases, but explosions may occur which result in the loss of scores of lives. Most of these explosions are preventable, and very strict regulations are in force in the pits.

At every pit a certain number of appliances to enable men to breathe safely must be kept at hand. These respirators provide the wearers with a supply of pure oxygen, so that it is not necessary for them to breathe the foul air of the pit. Explosions or roof falls within a pit are usually followed by clouds of invisible but poisonous gases. Fire-damp, which is explosive, black damp, and white damp are the most common.

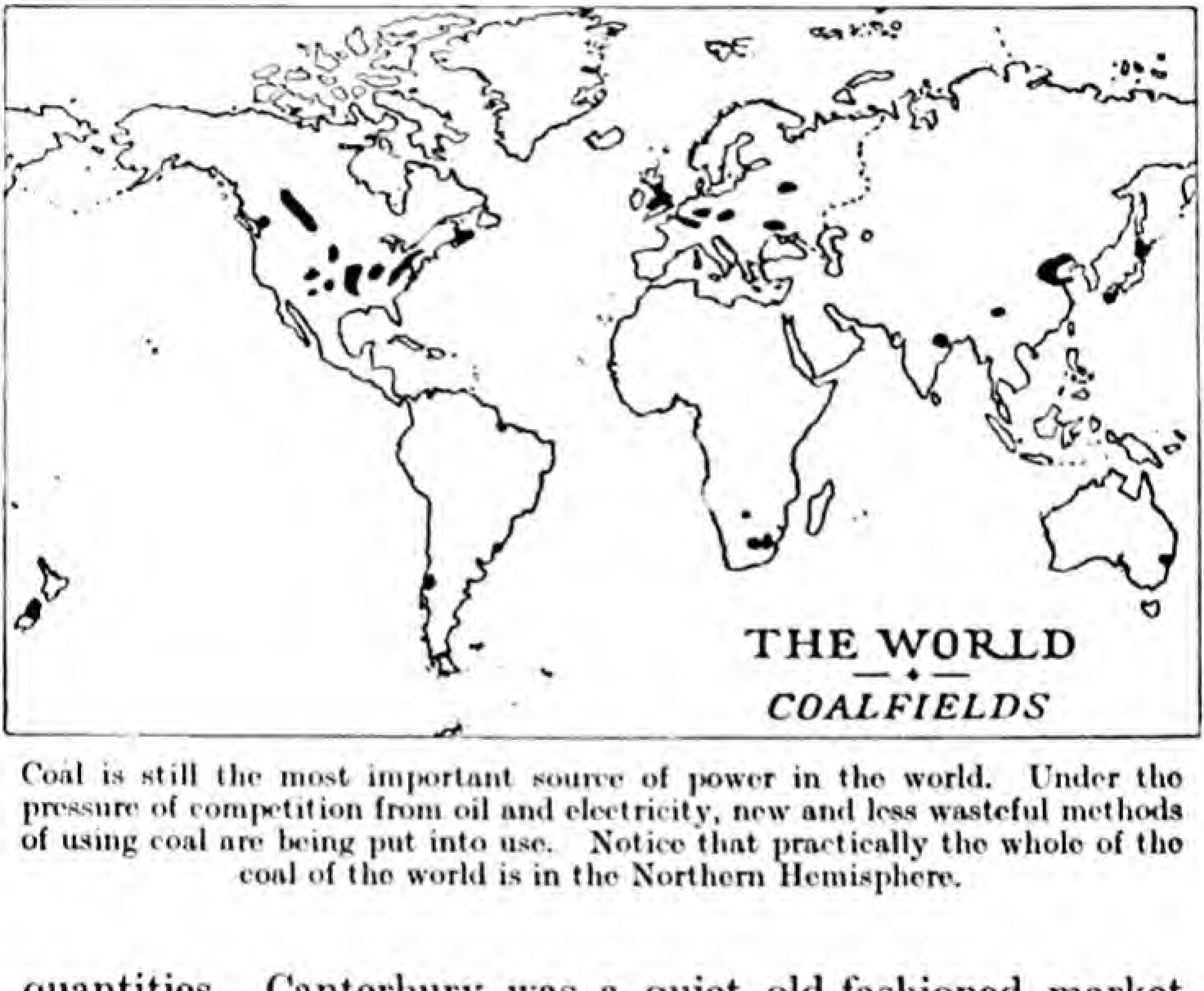
White damp, or carbon monoxide, is deadly in its effects. Men become dizzy, stagger, and fall within a few seconds of entering the gas. Now it so happens that small creatures like mice or canaries are affected much more rapidly than men, so the law requires that at every pit at least two mice or canaries should be kept handy. Directly the bird shows signs of being overcome, the rescue party know that there is gas about.

Each man also wears an electric headlamp and a small horn with which to signal to the others, and the party also carry an oxygen reviving apparatus. This is used if a man is discovered unconscious. It may be possible to save his life by placing the mask over his nose and mouth, and, by pressing his lungs, cause him to breathe in oxygen which washes out the poison gas.

The chief coal mines of Britain are found along the flanks of the Pennines both on the eastern and the western sides, in the Midlands, and in South Wales. Coal is also found beneath the farmlands of Central Scotland, and there are several smaller coalfields in England, in the Severn Valley, near Bristol, and in East Kent.

This last coalfield has only been developed during the past few years, and gives an interesting example of how the life of a district is altered by the discovery of coal.

Before coal was discovered in East Kent the district was entirely agricultural. Sheep were reared on the North Downs, while wheat, barley, and fruit were grown in considerable



Coal is still the most important source of power in the world. Under the pressure of competition from oil and electricity, new and less wasteful methods of using coal are being put into use. Notice that practically the whole of the coal of the world is in the Northern Hemisphere.

quantities. Canterbury was a quiet old-fashioned market town, where the farmers sold their produce and drove in their sheep and fat stock to market.

This side of the life of the countryside still continues, but with the opening of the pits, workers began to arrive from Wales and other colliery districts. Large villages of modern houses have been built near the pits, and the life of Canter-

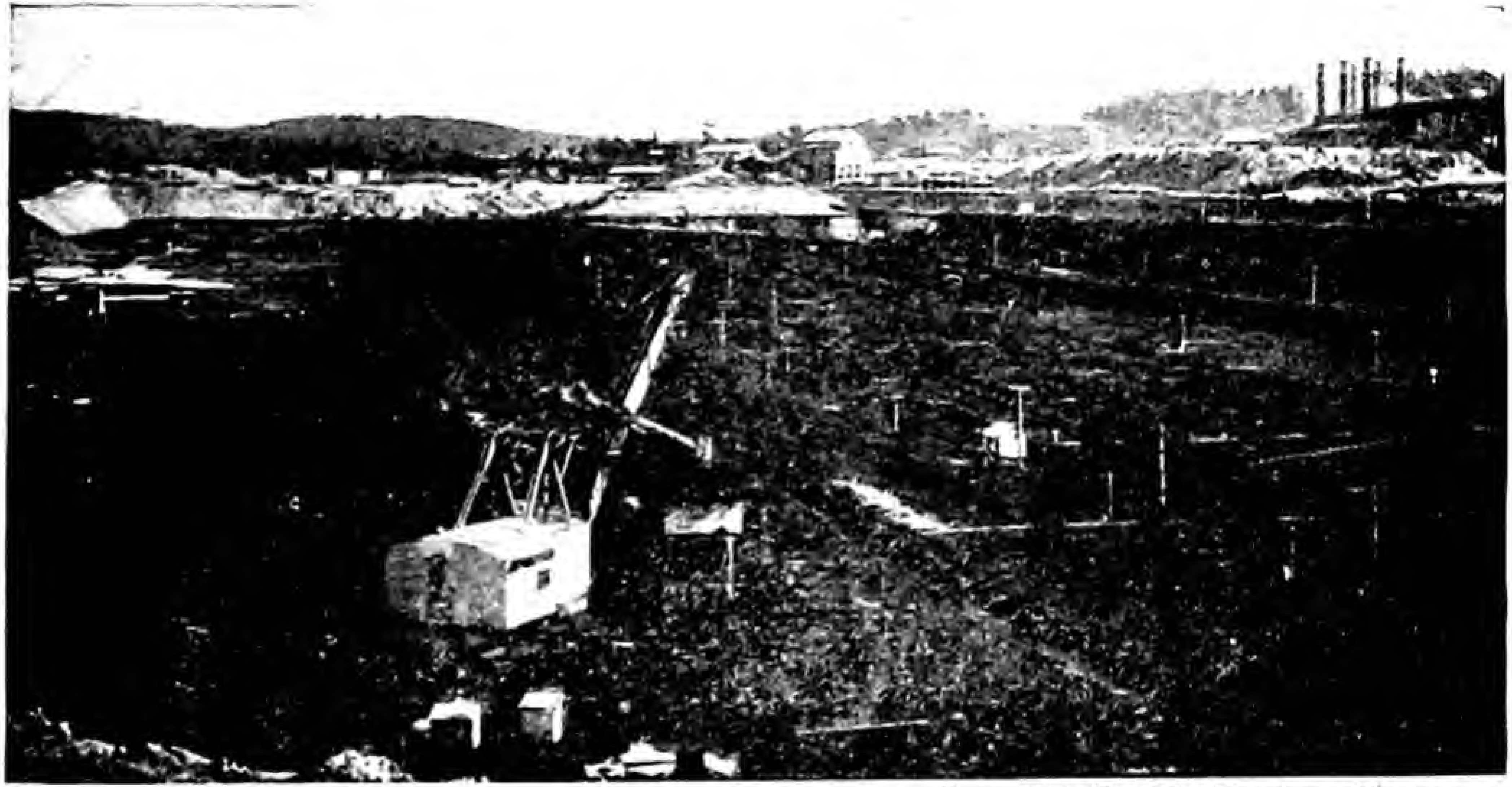
bury has changed. Large multiple firms of grocers and tailors have opened shops. Old shops have been either enlarged or pulled down to give place to modern stores. Cinemas have been built, and the quiet old-fashioned cathedral town has now become a smart up-to-date centre for the new workers, who have more money to spend than the agricultural workers on the farms.

In Europe the coalfields are found scattered along a line to the north of the mountains, and extending from North-east France and Belgium, through the Ruhr, to Saxony, Silesia, and Southern Russia. These regions therefore possess many large factory towns, with networks of railways and roads.

The most productive coalfield in the world is in North America. It lies to the west of the Appalachian Mountains, and extends from Pennsylvania in the north to Alabama in the south. Its two great centres are Pittsburgh in the north, and Birmingham (Alabama) in the south. It has been estimated that this huge coalfield possesses reserves large enough to supply as much coal as all the existing coalfields of the world do at present.

The coal lies in regular, level seams just below the surface of the plateau. In the north this plateau is drained by the tributaries of the Ohio, the Allegheny, Youghiogheny, and Monongahela, which all meet near Pittsburgh. These rivers have cut down their valleys into the coal seams, so that workings can be driven into the valley sides, thus avoiding the use of shafts and enabling the coal to be delivered cheaply to the barges on the rivers or to the railways on their banks. There are also pits, of course, but these are farther from the rivers.

It is possible in these mines to make a greater use of machinery, since ventilation is easier and the seams are



Photo—State Electricity Commission of Victoria.

THE GIPPSLAND COALFIELD, VICTORIA.

This is an open working, as the coal is close to the surface. The coalfield covers 50 square miles, and is 780 feet thick. The electric shovel in the foreground, which is only one of a number, tears out six tons at one bite, and delivers 2,000 tons a day to the trucks. The coal is a soft brown kind called lignite, and is used in a great power house beside the workings to generate electricity at 132,000 volts. This provides power and light for Melbourne, 100 miles distant, and to other places even 250 miles away.

regular, whereas in Britain the seams are often folded or crumpled, and ventilation is difficult. Electric "mules" or haulage engines are extensively used in American pits. Similar haulage engines are also used in the more modern British pits, but, on the whole, British collieries rely more upon cable haulage and conveyors, which are more suited to their conditions.

While Pittsburgh is the natural centre for the coalfield, it is surrounded by coal and steel towns. The total annual output of coal in Pennsylvania alone is greater than that of Britain.

Canada possesses two important coalfields. That on the east is on Cape Breton Island, Nova Scotia, at the entrance to the Gulf of St. Lawrence. It supplies a great deal of "bunker" coal to the shipping using the Atlantic ports of North America, and Sydney is an important coaling station. There is also some coal in New Brunswick.

The other Canadian coalfield is in the west of Alberta. Much of the coal is used by large power stations at the pit-heads. The electricity thus produced is distributed over a great part of Western Canada. It also provides power for factories, steel works, and engineering works. In this way Alberta, which a few years ago was a thinly populated farming and ranching province, has now several growing industrial towns such as Edmonton, Lethbridge, and Medicine Hat. This field also supplies fuel for the railways of Western Canada.

The coal of Asia is found in Siberia, China, Manchukuo, and Japan. The Siberian fields are not as yet much developed. In China the chief coalfields are in Shansi in the north, and near Hankow in the Yangtze valley. The mining is largely controlled, as in the case of iron, by Japanese companies.

Japan itself possesses important coalfields in the island of Kiushiu. The chief centre is Nagasaki, a great ship-building and steel town, which may be regarded as the Newcastle of Japan.

In Manchukuo, the coalfield of Fushun, close to Mukden, is by far the most important, supplying over 5,000,000 tons of good coal per year. The seams of coal are of enormous thickness and are of high quality.

Unlike most coalfields, the Fushun mines are open workings without deep shafts and pithead gear. The lines from the workings all converge to feed the screening and washing plant on the main railway.

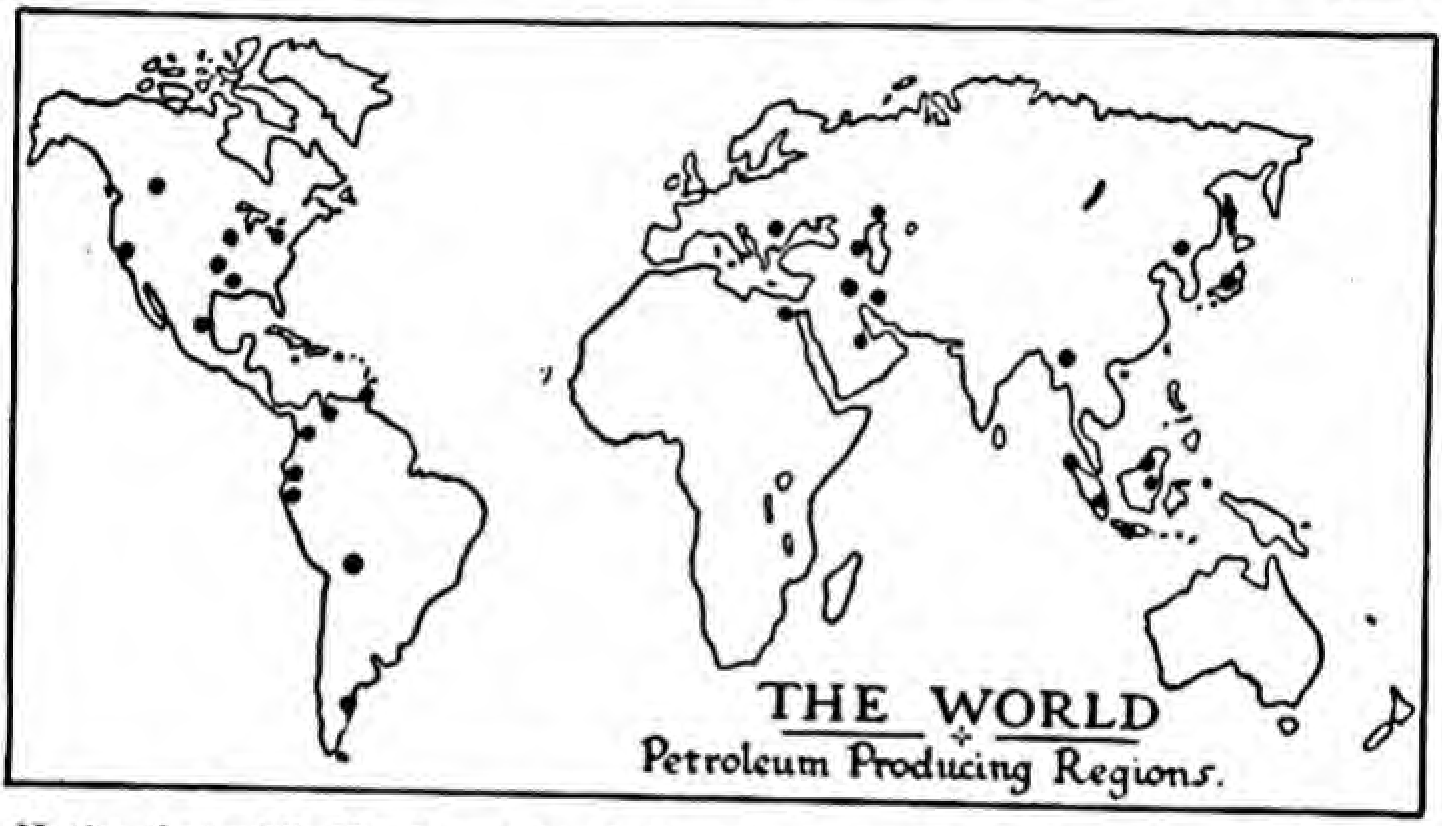
The Fushun mines are owned by the South Manchurian Railway, which belongs to Japan. It is close to the important railway centre of Mukden, and the bulk of its output serves to supply Japanese industries. Manchukuo possesses coal reserves at least equal to those of Japan, and, as we have seen, more than ten times the reserves of iron ore. Hence Japan is becoming more and more dependent upon Manchukuo for the regular supplies of coal and steel needed for her factories, engineering shops, and shipbuilding yards. Coal is now the third most important export of Manchukuo, following soya beans and cereals.

In the Southern Hemisphere there are four small coalfields. The most important of these is the Hunter Valley, on the coast of New South Wales to the north of Sydney. The chief town is Newcastle, which, like its namesake in England, supplies good "bunker" coal for the ships which trade with Australia. Behind Newcastle, factory towns and steel works are beginning to be built, for up to a few years ago Australia had to buy all her machinery and manufactured goods from abroad. The Hunter Valley coalfields will help Australia to make some of these things for herself.

New Zealand possesses a small coalfield at Westport in South Island. This coal is also used for ships.

The second most important coalfield in the Southern Hemisphere is in Natal, to the north of Durban, which acts as the outlet for the coal. This makes Durban the most important coaling port on the Indian Ocean.

Another small coalfield, at present but little developed,



Notice that while North and South America are particularly rich in oil supplies, Africa, Australia, and Western Europe have practically none. More than half the oil supplies of the world come from the U.S.A.

is on the Straits of Magellan in the extreme south of South America.

Owing to the dependence of the shipping of the world upon coal for fuel, it has become a habit to store large quantities of coal at convenient ports to supply ships which need it. Such coaling stations are usually where several shipping routes meet, and there is a regular traffic in coal between the important coal-exporting centres such as South Wales or Newcastle and the coaling stations.

The great naval powers of the world also maintain their

own private stocks of fuel at various points for the use of their warships. The more important coaling stations of the world are British. Port Said, Aden, Colombo, Singapore, Hong Kong, Victoria (on Vancouver Island), and Kingston (Jamaica) are all coaling stations as well as busy ports.

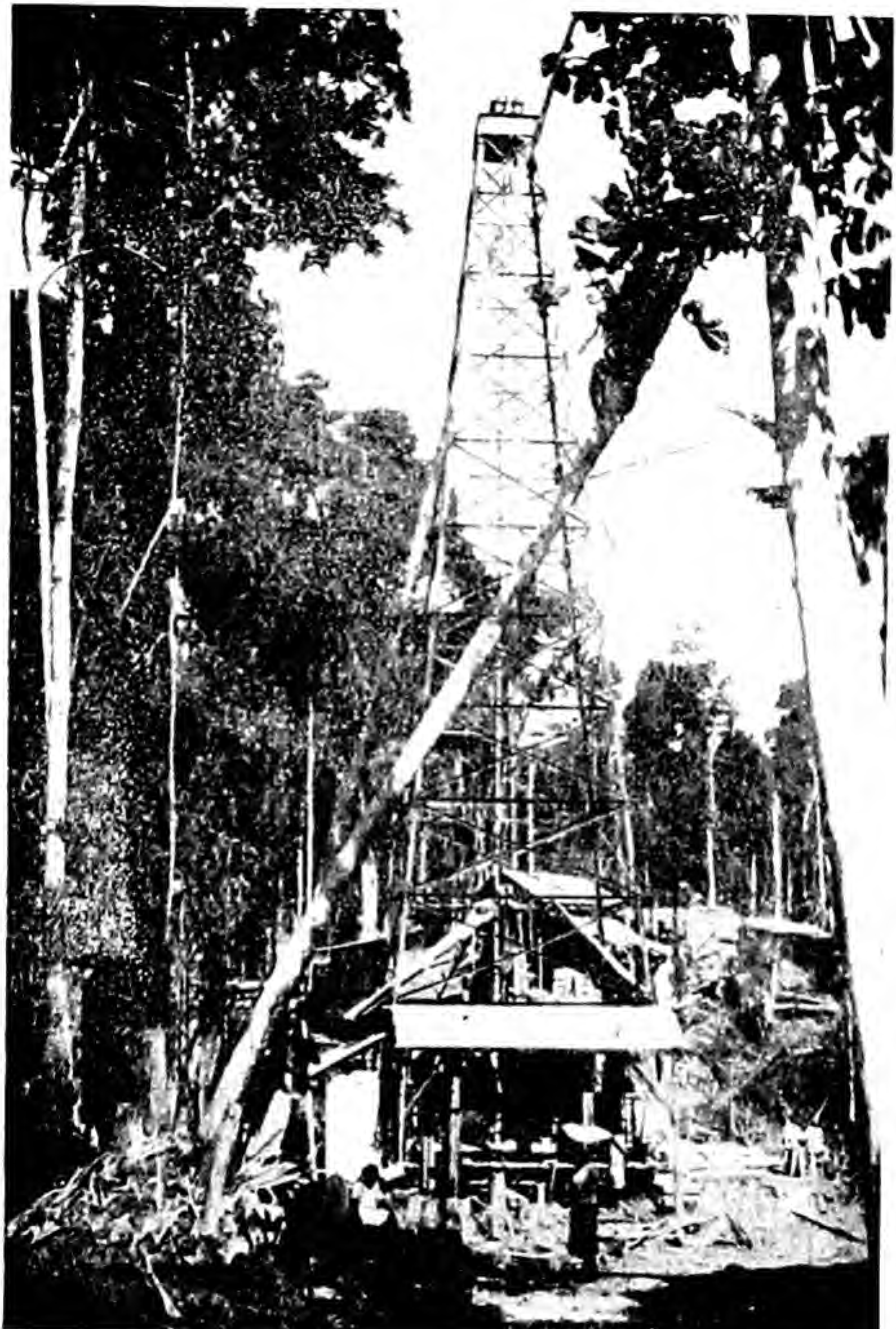
Owing to the rising cost of coal-mining, efforts are now being made in some countries to make use of a cheaper form of fuel. This is *lignite*, a kind of soft coal, which can be burned in special power stations. Lignite is usually found near the surface of the ground, and is obtained from open workings. The largest lignite power stations in the world are in Central Germany. There are also important mines in Gippsland in Victoria (Australia), and these supply power for industries at Melbourne (see picture on page 218).

OIL

Nowadays oil has become a very serious rival to coal as a source of power, being used not only in the form of petrol for motor vehicles, or paraffin for small general-purpose engines, but as heavy oil for Diesel engines, for big ships and power stations.

Oil is a mineral, and is found in beds of oil-bearing rock in various parts of the world. To reach the oil a deep bore-hole has to be made. To make this hole a " derrick " or lattice-work tower is erected, and this holds the boring machinery in position.

The bore-hole is a few inches in diameter, and is lined with a pipe through which the oil rises to the surface. Mineral oil contains a large quantity of gas, and this gas usually helps to force the oil to the surface, much in the same way that the gas in a soda-water syphon forces the soda-water out when the trigger is pressed.



AN OIL WELL IN TRINIDAD.

This photograph shows the derrick, or steel scaffolding, which is used during boring and casing the well. It stands in a forest clearing. The bore-hole is over 1,000 feet deep.

For the first few days an oil well usually flows very plentifully, but the yield of oil then drops, and after a time it may be necessary to pump the oil to the surface. The top of the bore-hole is " capped " by a pipe and valve to control the flow of oil.

After passing through an apparatus which removes the gas, the oil is stored in large tanks or even in an open reservoir, from which it is pumped through a long line of pipes to the refining works near the sea. Some of these pipe-lines are very long.

The United States is the most important oil-producing country in the world. The oil is found in Pennsylvania, and pipe-lines take it to such ports as Baltimore and New York. Other oilfields are beneath the great plains in the centre of the country. Much of this oil is exported from ports such as Galveston on the Gulf of Mexico. There is also an important oilfield near Los Angeles in California. This supplies oil for the Pacific coast.

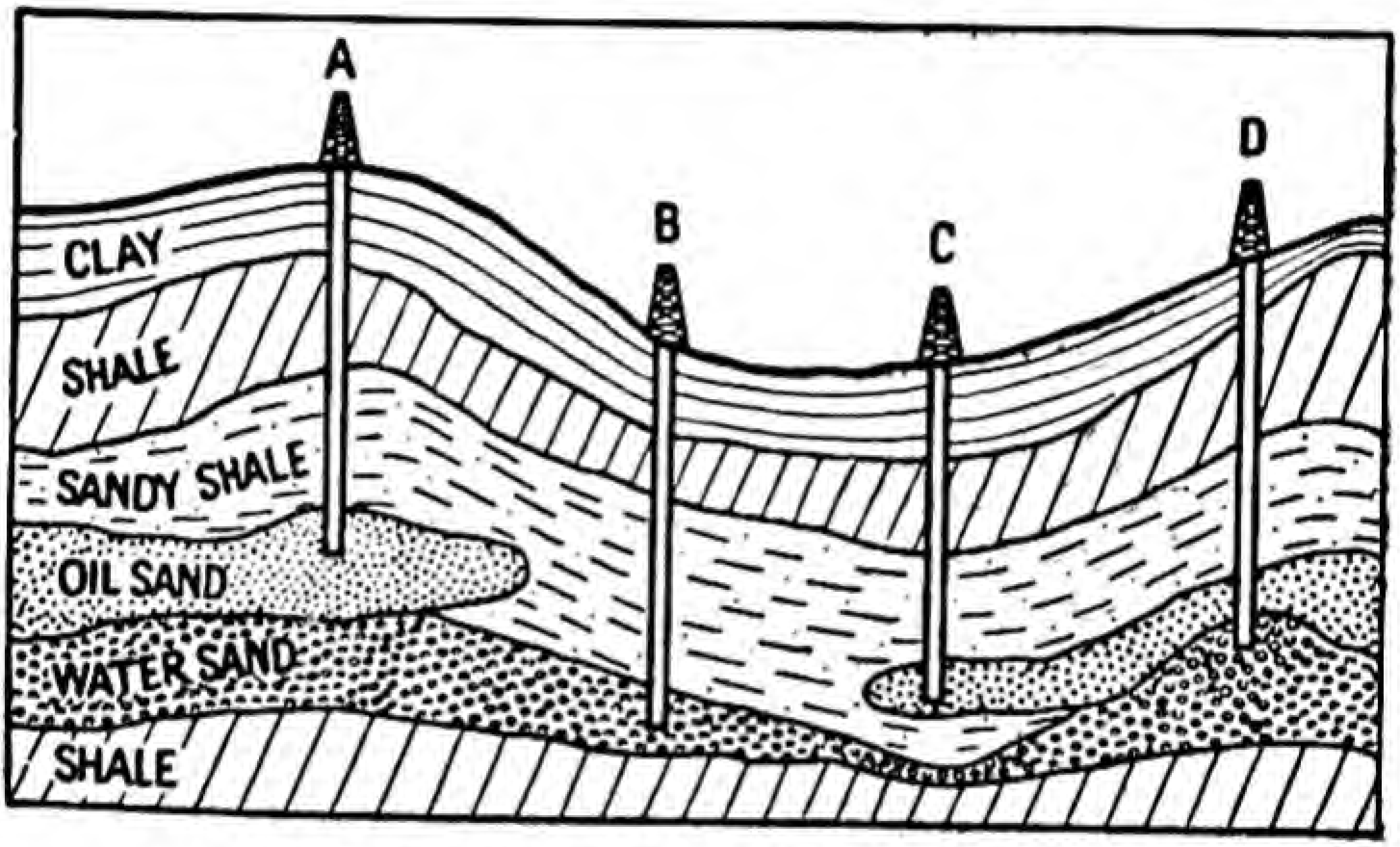
There are many valuable oilfields in Eastern Mexico, and in various parts of South America, especially in Venezuela and along the Pacific coast in Peru. No oil has yet been developed in Africa, but there are several important oil-producing areas in Europe on the flanks of the Carpathian Mountains in Galicia (Poland) and Rumania.

Russia possesses rich oil wells in the Caucasus, on the Apsheron Peninsula in the Caspian Sea. Baku is the great oil centre, and the oil pipe-line runs to Batum on the Black Sea.

In Asia the most important oilfields are in Iraq, near Mosul, and in the south of Iran (or Persia). Important pipe-lines carry the oil from Mosul to Beirut on the Mediterranean Sea, while that from the Iran field goes to Mohamarrah, an island port near Basra, at the mouth of the river Euphrates.

Other valuable oilfields are in various islands of the Dutch East Indies and in Burma.

Mineral oil is not only used as fuel, but it yields lubricating oils and also bitumen or pitch, which is used for road-making. Owing to the absence of oilfields in Britain, the government have encouraged the manufacture of motor fuel



WHY SOME OIL WELLS ARE USELESS.

Mineral oil only occurs in what is called "oil-sand" or "oil-bearing shale." Underneath these oily layers there is usually sand or shale containing salt water. Well A is drilled to the oil-sand. The pressure of the gas in the oil will force the oil to the surface, and this well will be very successful. Well B has missed the oil-sand, and will yield little or no oil. Well C has tapped the oil-sand, and will be quite productive; but Well D has been drilled too deep, reaching the water, which will hinder or stop the flow of oil.

from coal and other materials. The motor fuel obtained from coal is known as benzol, and is produced by many of the larger gasworks. There is also a method of producing the fuel direct from coal.

In South Africa, which also needs oil, a good motor fuel called Natalite is produced from cactus plants.

The most important centre for the production of "British Made" oil is a few miles to the west of Edinburgh. Here there are valuable layers of a slaty rock called oil-shale. This rock is mined much in the same way as coal, and after it has been brought to the surface it is heated in long ovens or retorts. This drives off the oil contained in the shale in the form of gas, which is cooled to obtain a heavy oil.

This oil is sent from the mines to a large central refinery where a large number of very useful substances are extracted from it. These include not only diesel oil and motor spirit, but naphtha, resin, paraffin wax, and even fertiliser. The remainder of the shale is made into bricks for building.

The Scottish shale-oil industry is very important, for in addition to providing a useful quantity of fuel oil, the other products help to promote other industries. Roofing felt and linoleum are made from the resin. The naphtha is used in the manufacture of paint and rubber, and much of it is needed for "dry cleaning."

Oil is such a convenient fuel and source of power that the people of the world are using more and more each year. No-one knows just how much oil there is under the ground, but it is certainly not inexhaustible. In 1935, 200,000,000 tons flowed from the wells, and it is doubtful whether we can continue to use oil at this rate without exhausting the supply within a generation. Some experts say that the oil supplies of the world will last fifty years, others rather less.

In any case, sooner or later, some substitute will have to be found, and it seems as though quite a good fuel can be obtained from coal. The world has sufficient coal to last for several hundred years.

CHAPTER XV

MODERN WIZARDS

OUR modern world is so wonderful, and we are so used to it, that we often do not notice the marvels around us. If an uncivilized native, from one of the remote corners of the earth, were suddenly set down in a street in a modern city he would be terrified. The simplest features of our everyday life would be to him supernatural. A motor car, a clock, an electric sign, or an aeroplane would produce feelings of awe.

When the first electric tramcars were seen moving along the rails in the streets of Bangkok, the capital of Siam, the people knelt on the ground and prayed to the spirits that they thought were moving the wheels. No-one dared to ride in them for a long time, until they found that the cars were quite harmless. The things which are done every day in modern factories are far more wonderful than an electric car, but we are so used to them that we take very little notice of them.

The modern factory makes use of all kinds of materials, and with the aid of special machines produces the most remarkable substances, each of which has an everyday use. We have seen how wood or plant fibre is changed into artificial silk, milk into buttons, and stone into metal. There are hundreds of other wonders of modern industry. Tar,

Photo: South African Rlys.

SORTING PEANUTS, NABOOMSPRUIT, TRANSVAAL.

Ground nuts, better known to British boys as "monkey nuts," are a very useful tropical crop. Native farmers in the Transvaal and in East Africa have begun to grow them for export.

the black sticky substance that is left behind when coal gas is manufactured, can be changed into hundreds of different products. Fragrant perfumes, colourful dyes, valuable surgical antiseptics, powerful explosives, agricultural ferti-

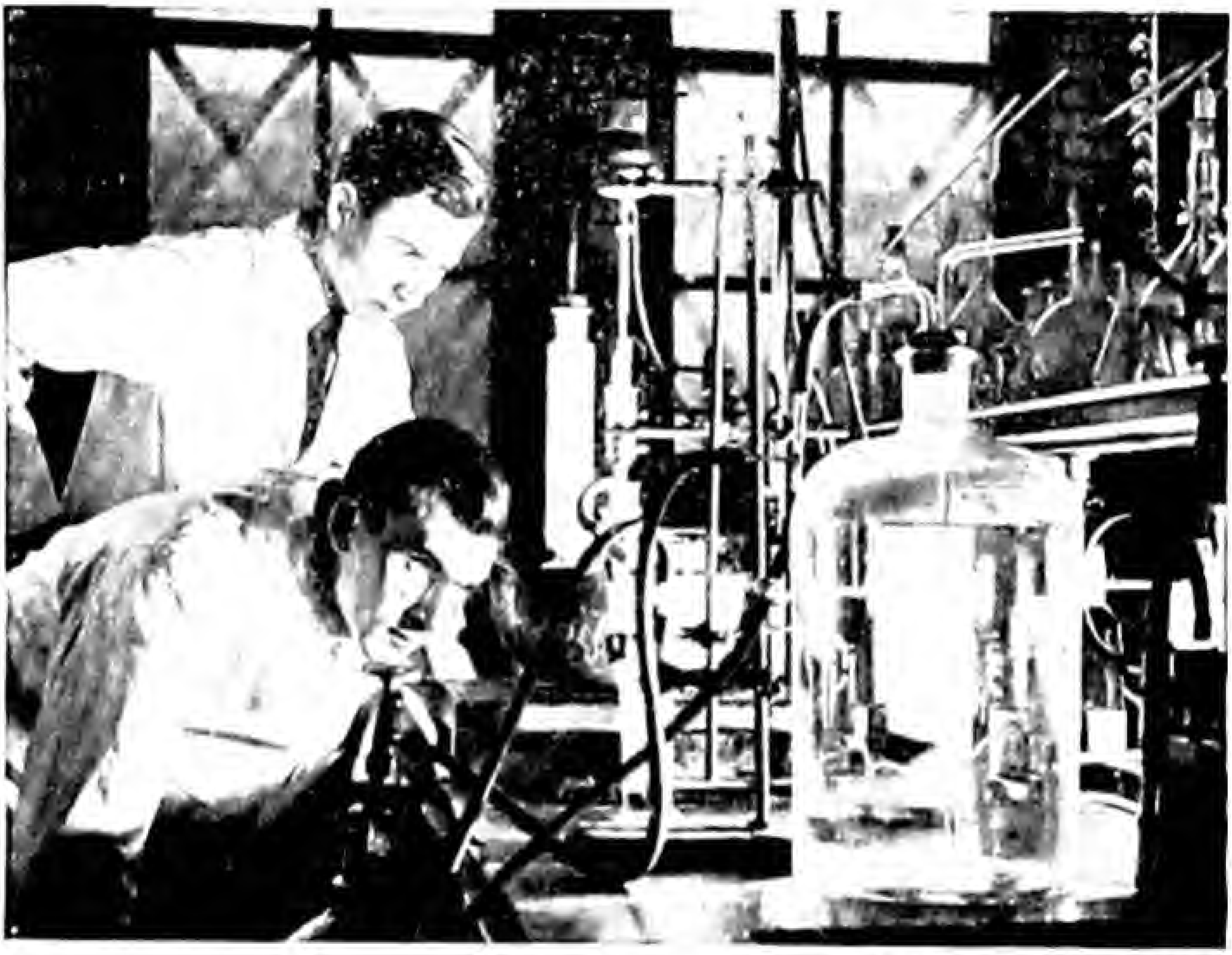


Photo: Fox Photos Ltd.

MODERN SCIENTISTS AT WORK

The wonderful and intricate processes which are used in modern factories and workshops have usually only been made possible by months, or even years, of patient work on the part of highly-trained scientists. This is a typical scene in a research laboratory, where two chemists are at work. What they are doing is secret. If they succeed, their work will bring fame and possibly wealth to them or to their employers. If they fail, they will try again.

lizers, are but a few of the 2,000 different substances that are manufactured from tar.

Another source of a number of useful materials is vegetable oil. There are many kinds of oil, most of them being obtained from the fruit or seeds of tropical plants. The only

Photo: Dept. of Agriculture, Trinidad.

COCONUT PALMS, TRINIDAD.

The coconut palm is one of the most useful plants in the world. Not only does it supply millions of people in the Tropics with food, drink, clothing, and beauty-cream, but the dried nut, known as copra, is sent by the millions of tons to the industrial districts of Western Europe and North America to be made into margarine or soap.

oils obtained from plants which grow in temperate lands are olive oil, soya bean oil, and linseed oil.

The most common of the tropical oils are those obtained from the fruit and kernels of the oil palm, from dried coconut (or "copra" as it is called), ground nuts, cotton seed, castor oil seed, and from the seeds of a number of plants

SHELLING COPRA IN THE WEST INDIES.

These workers, after splitting the nuts with an axe, are scooping out the white nut. This will then be dried and sold to a trader. The price paid varies from sixpence to tenpence for a hundred nuts, but usually the trader gives goods in exchange rather than money.

which are generally called "oil seeds." Even sunflower seeds and hemp seeds yield valuable oils. The cultivation of these seeds employs millions of workers, and the farmer in India, China, and West Africa looks upon them as one of the most useful of his crops.

The preparation of the oil from these seeds is not usually

carried out by the farmer, but in large mills in Europe or North America. In general the method is the same for all oil seeds. They are first bruised, or partly crushed, and are then cooked by steam to melt the oil. The masses of seeds are next wrapped in woollen cloths, and the oil is squeezed out in huge presses worked by machinery. What is left of the seeds is sold for cattle food.

Most of these vegetable oils can be used as food; either as cooking fats, as salad oil, or as margarine. Some are used for packing sardines and other foods. The colour, flavour, and quality of the oil determine what it will be used for. In some cases the flavour or the smell of the oil can be removed before it is used.

To make margarine, the oil, after being purified, is churned with skimmed milk. The yellow colour (which is obtained from certain West Indian seeds) is added, and the resulting product can be made to look and taste like butter. The vegetable oils most used for margarine are from copra, palm kernels, cotton seed, soya beans, and ground nuts. Some of these "oils" are more like grease, and have to be warmed to make them liquid.

If the oil is boiled with caustic soda, soap is obtained. The soap boiling is done in huge tanks, heated by steam, and takes from three to four days. The hot liquid soap is run out of the tanks along troughs to large moulds in which it cools, becoming solid. Each mould may hold as much as a ton of soap. The huge blocks of soap are cut up into bars, which travel to machines which cut and stamp them into small bars, ready for packing. Toilet soaps are made from ordinary soap, shredded, coloured, scented, and remoulded into pieces, ready for wrapping.

As soap and margarine are made from much the same oils, most of the big soap-making firms also make margarine,

IN A MODERN SOAP WORKS.

The great vats on the left contain a mixture of fat (obtained mainly from tropical plants) and alkali, which is being boiled by steam for several days. When this is completed the mixture will have turned into soap, which will be run off along troughs to the moulds, where it will cool and solidify. It will then be ready to be cut up and packed.

though not, of course, in the same works. The seeds are crushed and pressed at the oil mills. The various kinds of oil are then separated and purified, and sent to the soap works or to the margarine works respectively. The largest soap and margarine combine in the world is British. It owns or controls tens of thousands of square miles of land in the Tropics, whole archipelagoes of islands, steamship lines, and even railways. It has factories in every continent.

Cooking fat is made mainly from cotton seed oil, while

LINSEED

salad oil is obtained chiefly from olives or ground nuts. Other oils are used in the making of paint, varnish, linoleum, and printing ink.

Castor oil, although familiar to many people as a medicine, is really a lubricating oil. When it has been blended with other oils it is used in lubricating engines or machinery which work at a very high temperature. Aeroplane engines and racing-car engines run on castor oil. This oil is obtained from the seeds of a plant which is widely cultivated in

certain parts of India, where the peasants also burn the oil in their clay lamps.

The great producing areas of the world for these useful oils are India, China, West Africa, and the East Indies for tropical oil seeds; Argentina for linseed; China and Manchukuo for the soya bean; the southern U.S.A., India, and Egypt for cotton seed. Olive oil comes from the Mediterranean lands, the most important areas being Spain, North Africa, and Italy. Another very important oil, which is used in paint and varnish to make it dry quickly, is "tung oil." This is prepared from the fruit kernels of a tree which at present is only grown in China.

Another useful plant substance that is in great demand nowadays is rubber. This is obtained from the milk-like juice, or "latex," which oozes from cuts in the bark of the rubber tree. This tropical tree was once only to be found in the Amazon forests of Brazil. It is now cultivated in vast plantations in Ceylon, Malaya, and the East Indies. The latex is collected daily, and is carried to the factory on the estate, where it is transformed into "crepe" rubber. This is exported to Europe and North America to be made into motor tyres, floor coverings, sponge rubber, mackintoshes, elastic, and many other substances. Mixed with sulphur it can be made into vulcanite—the hard black substance of which the barrels of fountain pens are made. The rubber industry employs tens of thousands of workers, apart from the growers, and it is said that over 40,000 different uses for rubber have been discovered.

Two other substances similar to rubber are balata, the gum of a tree found in British Guiana, and gutta-percha, which comes from Malaya.

Among the mineral substances which can be transformed by the modern chemist, the most important is salt. Years

A TYPICAL RUBBER PLANTATION IN MALAYA.

ago salt used to be mined in Cheshire in the form of rock salt, which is a glass-like crystal rock. It is still obtained in this way in certain parts of the world, especially in Germany, near Salzburg, and in Poland. At Wieliczka, in Galicia, there are the largest salt mines in the world, with streets, houses, and monuments cut from the crystal rock, and served by more than thirty miles of underground railway.

Salt is also obtained by evaporating sea-water, and from the dried-up beds of former seas or salt lakes. The modern method of obtaining salt, however, is in the form of brine. Underneath the Cheshire plain, and in one or two other parts of England, there are large beds of salt. Bore-holes are made, often near the old mines which are now flooded, and the salt water is pumped up and sent along pipe-lines to the big chemical works.

From this brine a number of very useful chemical substances are made, including what is called "soda ash" (a form of washing soda), caustic soda, bicarbonate of soda, and bleaching powder. The soda ash, in different forms, is used for hundreds of everyday purposes—in making glass, soap, glycerine, and artificial silk, for softening water, and for purifying steel. In fact there is hardly a factory product, from a toothbrush to a tramcar, in which soda ash has not been used to help in its manufacture. The great textile industries of the world could not continue without the use of soda for cleansing, and bleaching substances for making the finished cloth white.

Bicarbonate of soda is used in baking and cooking, and to help to put the fizz into health salts.

Even more remarkable than this is the way in which common substances such as air, water, and coal can be combined together to make other very useful substances.

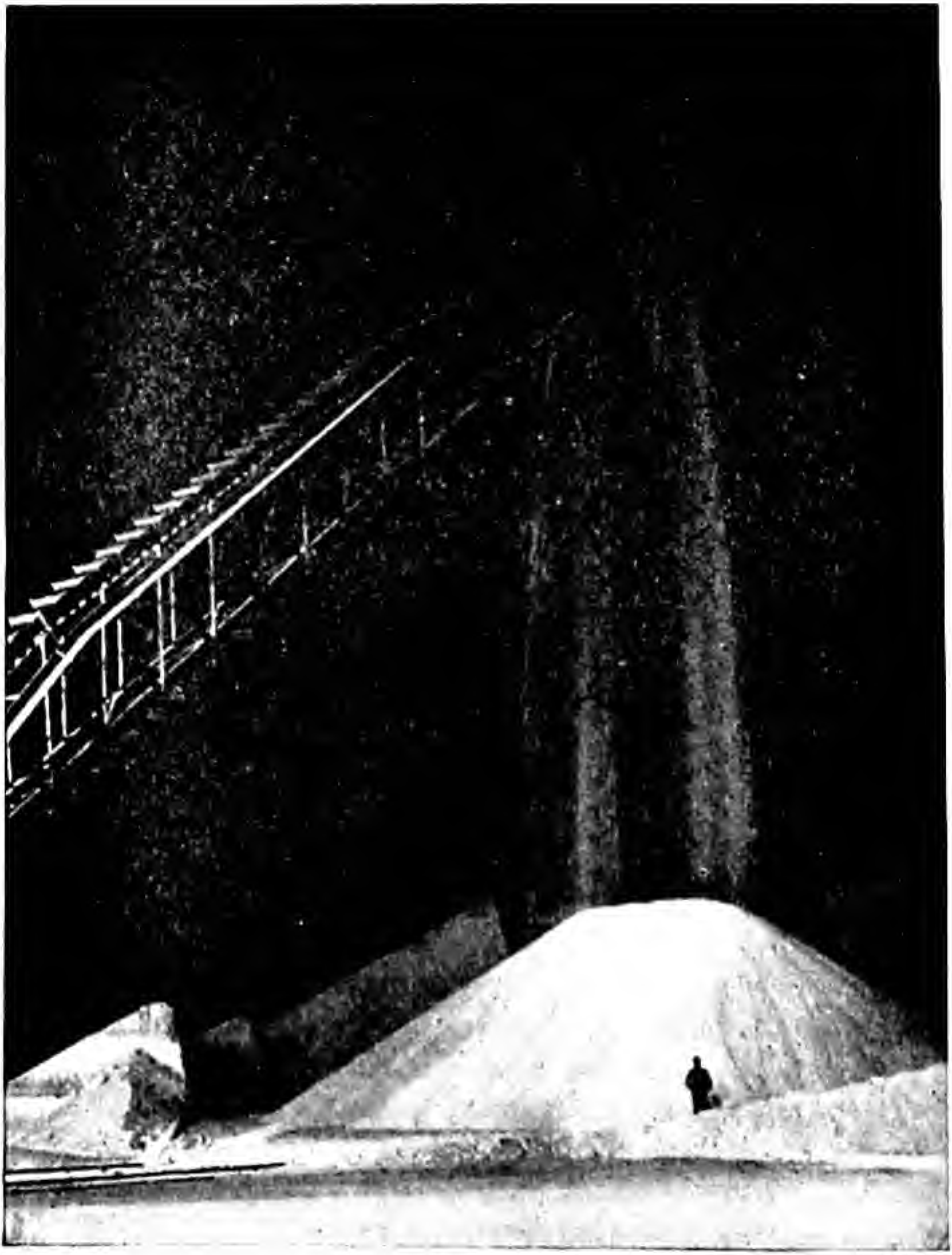


Photo: I.C.I. Ltd.

A THOUSAND TONS OF FERTILIZER.

This hill of white substance is sulphate of ammonia, a valuable fertilizer which is used by farmers all over the world. This photograph is taken inside a storage tower, or silo, which can hold 100,000 tons, at Billingham, the great chemical town on Tees-side. The arm of a giant elevator can be seen on the left.

Photo: Exclusive News Agency.

A LAKE OF SOLID SODA, EAST AFRICA.

A view of Lake Magadi, near the border of Kenya, about half-way between Mt. Kilimanjaro and Lake Victoria. This remarkable lake, twenty-five miles long and four miles wide, is practically solid washing soda. There is sufficient to supply the needs of the whole world for many years. A special railroad, 100 miles long, links Lake Magadi with the main Uganda railway to Mombasa.

At Billingham, near the mouth of the Tees, are huge chemical works where these wonderful things are done. These works, which are the largest of their kind in the world, are just where they are because, 900 feet underground, are supplies of a rare mineral containing sulphur which is needed in the process. With the help of this mineral the engineers make fertilizer, which is supplied to farmers all over the world, sulphuric and nitric acids which are needed to make explosives, petrol for the motorist, cement for builders, and many useful chemicals.

Some of these are needed in making bakelite, of which all kinds of articles are now being manufactured. The

engineers at Billingham also make drikold, which is a frozen gas, intensely cold. It is sold in small bricks, one of which if placed in the larder will keep the place cool for hours, even during the hottest weather. Drikold is also used for keeping cool the vans in which ice cream, meat, fruit, and fish are transported.

One of the greatest triumphs of the modern chemical engineer has been to make use of the waters of the Dead Sea. This great inland sea is situated in a hot and almost rainless region, nearly 1,300 feet below the ordinary sea-level. The water is so richly charged with chemicals that nothing will live either in the sea or on its salt-encrusted shores. Now, at the northern end, are big chemical works. The water is pumped up from the deepest part of the sea (where there are most chemicals in it), and passed into immense shallow pans. These pans cover an area of 1,000 acres, and the water flows slowly from one pan to another. The heat of the sun evaporates the water, leaving the chemicals in the bottom of the pan. These are regularly removed to the chemical works, where they are separated and purified.

Five very useful materials are extracted from the Dead Sea water. The most important of these is potash, a fertilizer that is very much needed by farmers, and bromine. It is remarkable that, from a place where no plants will grow, fertilizers to increase the farmers' crops is being produced in increasing quantities. It is said that the Dead Sea contains sufficient of these valuable chemicals to last the world for 2,000 years.

Chapter XVI

TRANSPORT

WHEN men first began to move about this earth they had to walk. There were no roads, no carts, no railways or aeroplanes. In fact, except for a few places, it was not easy to move about the earth at all in those days. The lowlands were covered with thick forest or jungle; the rivers were wide, and their banks were usually marshy; the hilltops were the only places where it was at all easy, or safe, to move. Even then the crossing of a valley, with its river or marsh, was a matter of great danger and difficulty.

Fortunately in those days it was not necessary for a man to move far from his home, for he fixed his home where he did not need to move much. He looked for a place where there was water to drink, food to eat, and reasonable shelter and protection from his enemies.

The first roads, if they may be called such, were made by the hunter, and even then they were but the tracks made by animals. These hunting trails were followed by the first travellers, who usually only moved because they had to do so, having been forced to seek another home through shortage of food, the overcrowding of that part of the earth's crust, or on account of some quarrel.

On the great river plains of the Old World where men cultivated the corn and fruit there was very little need to move, and so no-one bothered to do so. Even to-day in such

lands there are tens of millions of people who have never moved from the village in which they were born, while the only people with whom they are acquainted are their brothers, cousins, or neighbours.

The folk on the grasslands have to be travellers, for

Photo: Hudson's Bay Company.

TRANSPORT IN THE COLD LANDS.

A dog team and sledge outside a Hudson's Bay Company's store in northern Canada. Nowadays the aeroplane is being used more and more for transport in the North-West, but dogs are still indispensable.

animals need fresh pasture from time to time, but in those regions roads are not needed. All ways are alike to the wandering herdsman so long as he can reach an appointed market by the appointed day.

Thus it was a very long while before men began to travel at all, and the only tracks that were followed were those along which certain enterprising folk carried such things as

salt, which could not be obtained locally. The great transcontinental roads of the early world seem to have been the salt-ways, and these were followed by traders for centuries and so became the first trade routes.

Closely linked with the question of travel is that of transport—carrying things. The first travellers had to carry whatever they took with them on their backs or on their heads. Most of these things were household goods, and as the job of looking after the house has always been undertaken by the woman, it was but natural that she should be expected to look after the household goods.

Another reason why the man did not carry anything was that the man's job is to fight and to protect his wife. He could not do this properly if he were encumbered with a load, and so for safety, if not for comfort, the woman carried the load and probably the baby on the top of it.

This method of transport is still the only one known to millions. It is the only method known to the natives of Africa and South America, and it still lingers even among civilized peoples. The Japanese gentleman still walks to the railway station in front of his wife, who carries all the luggage.

Human porterage is the only possible means of crossing certain mountainous parts of the earth's surface. Each year several millions of pounds' worth of goods are carried over considerable distances on the heads or backs of men or women, especially in Central Asia, in the African forests, and in the jungles and mountains of South America.

This method is, however, very slow and very limited. Few people can carry more than a hundredweight and a half without feeling tired. Even a hundred men cannot carry more than seven tons of goods, say a railway wagon-load, faster than three miles an hour. The world could not

TRANSPORT IN THE DRY LANDS.

A camel train, carrying mining machinery and supplies across the dry trails of north-western Australia. The drivers are Afghans.

possibly live as it does to-day if we still had to rely entirely upon human transport. Some kind of vehicle is essential.

The first to be invented was the sledge. It had no wheels, but it was soon found that one man could drag twice or three times the weight that he could carry. The sledge was not only used in regions of snow, as it still is to-day, but was in general use in other lands. Strange as it may seem, the sledge was in regular use all the year round in England up to about two hundred years ago.

The sledge, however, is very clumsy, and it was not long before the first civilized people, the Babylonians, invented wheels. This must take its place beside the discovery of fire, of metals, and of food preservation as one of the great finger-posts of progress. Without wheels the modern world would not exist.

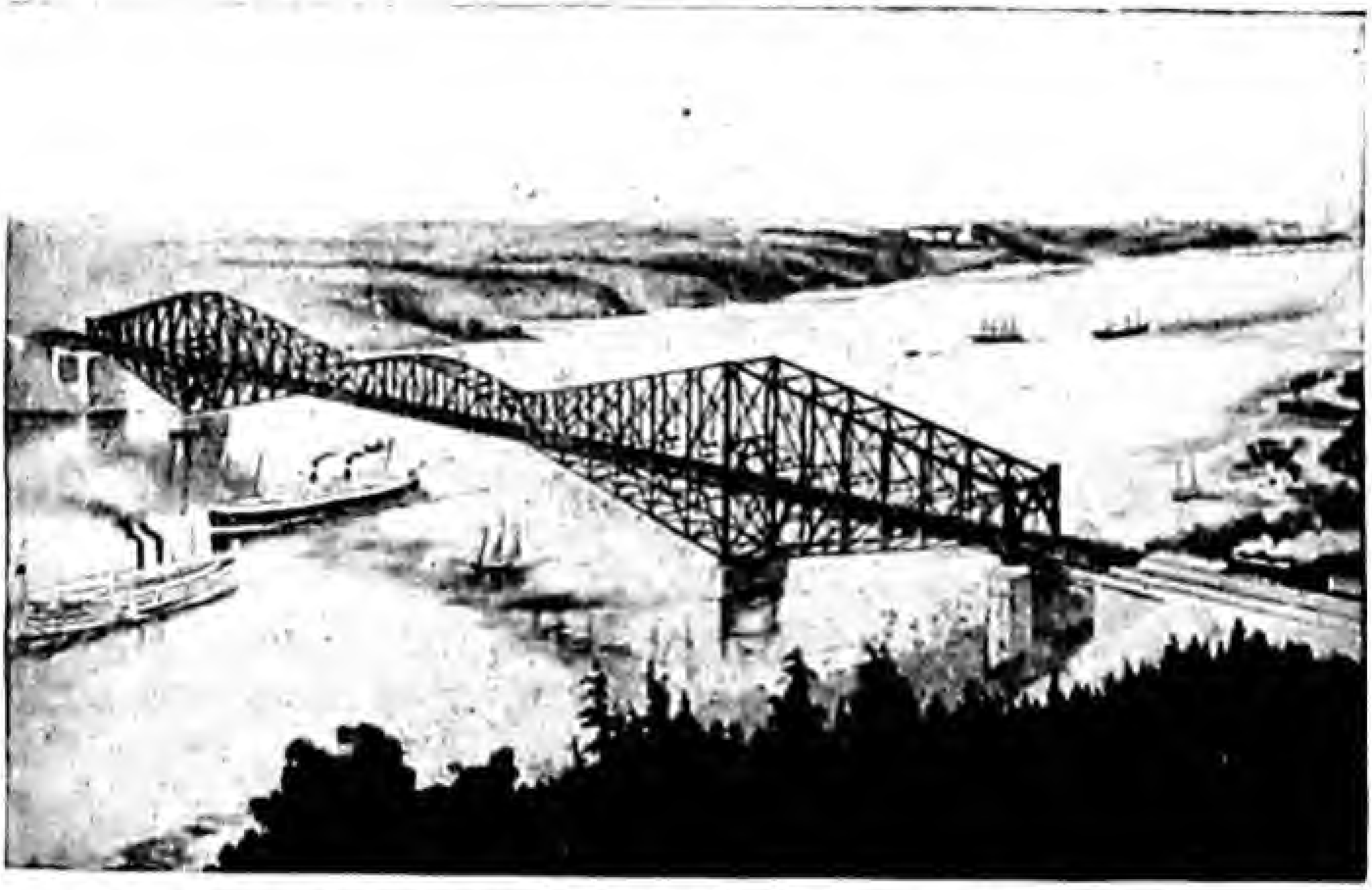
The first chariots, carts, and wagons were very primitive affairs as compared with our modern smooth-running, rubber-tyred vehicles, but they did their job for thousands of years. Even to-day in India by far the greater part of the traffic of that crowded land is carried by creaking, springless carts, whose wheels scream as if in agony as they lumber along.

ROADS

With the use of wheeled vehicles came the need for proper roads. These, however, were very slow in coming into existence; for the ordinary cart or wagon was used mainly by the farmer or the wool trader. The first real roads were made for soldiers. We all remember the Romans as great road builders, and these enterprising and resourceful people constructed the first network of arterial roads in the world.

While the making of roads is an evidence of civilization,

we must not think that the Romans constructed their roads merely to improve the world. The roads were the way by which they held their far-flung empire. It was vital that the Roman commanders should be able to move bodies of men rapidly from one danger-point to another. So they



QUEBEC BRIDGE—A VITAL TRANSPORT LINK.

Modern engineers, by using bridges or tunnels, are able to cross wide rivers or high mountain ranges which may have been a hindrance to transport for centuries. This great bridge at Quebec is a vital link in the shortest trans-continental route across Canada. It crosses the St. Lawrence, here nearly a mile wide, not far from where Wolfe's men scaled the Heights of Abraham.

made their roads hard and straight, paving them with stone where necessary, draining the marshes and bridging the rivers.

These Roman roads were narrow, being just wide enough for four soldiers or two horsemen to move abreast. They were not constructed for vehicles, which could never have surmounted the steep hills or crossed the narrow bridges.

They remained for fifteen centuries the main arteries of traffic for pedestrians and pack animals, and even to-day most of the main roads of Europe are along or parallel with those Roman roads.

What the Romans did for the Old World the Aztecs and Incas did for the New World. When Cortez reached Mexico,

TRANSPORT IN SOUTH AFRICA.

Oxen are used for transport in South Africa and in parts of Australia. Teams of from twelve to twenty oxen haul huge tall-wheeled wagons, carrying loads of five or more tons, over the roughest of roads (or no roads at all) and where there may be no bridges.

in the beginning of the sixteenth century, the Spanish invaders found not only a network of regular roads, but a regular traffic along them. Pizarro, the conqueror of Peru, also discovered a regular road system that was kept in good order by the Inca rulers. Moreover, these natives of South America paid rates for the upkeep of the roads long before such a thing was thought of in England.

With the great development of trade, and the building of

factory towns, there came a great demand for more and better roads, especially in England. When woollen mills were making cloth for export to China and other countries, business men found it necessary, not only to write and send letters, but to make journeys of considerable length. So coaching roads were made.

These coaching roads were fast and straight. They led from the busy factory towns to the great ports or commercial centres, and between the larger cities and the thriving health resorts. Many of them followed the line of the old Roman roads, which were widened and levelled. New roads were also made.

Practically all these roads were toll roads built by private people, who closed them by gates and charged a toll to all who used the road. Many of the old toll-collectors' houses are still to be seen at road junctions to-day.

At last the Government decided to take over the business of providing and looking after the roads, and this is now done for the Government by the various county councils.

The coaches were fairly fast. Many speed records were set up, and the most famous coaches were as well known as the "Flying Scotsman" or the "Cheltenham Flier" are known to-day. But they were not fast enough, and at the beginning of the present century the motor car made its appearance.

The coming of the motor car has revolutionized the roads, which have been widened and straightened so that very high speeds have become possible. New roads have been built compared with which the old Roman roads are mere country footpaths.

Unfortunately these roads are still used by all classes of travellers, from tramps to millionaires, and by all classes of

RIVER TRANSPORT IN THE TROPICS.

In tropical countries dense forest is a hindrance to road, rail, or air transport, so that the rivers are the main lines of communication.

vehicles, from a wheelbarrow to a Rolls-Royce. A great deal yet remains to be done to improve the roads.

The roads of the future will be wide and straight with no unnecessary twists. There will be different classes of roads for different classes of users, and probably each road will be divided into two parallel tracks for traffic in each direction. The road surfaces will be smooth but not slippery, and the main roads will be lighted the whole of their length

to render glaring headlights unnecessary. Roads will cross each other by bridges, and the junctions of roads will be arranged as carefully as a railway junction, and controlled by automatic signals. There will be commercial roads for the heavy twenty-tonners, and motor roads will be restricted to motor vehicles. In the cities horse-drawn vehicles will be prohibited.

All these improvements are now making their appearance in one land or another, but it is probable that by the time the road systems of the world have been perfected no-one will want to use them, for everyone will travel by air.

RAILWAYS

Before we consider this, however, it is necessary to consider the railway. Practically every country upon earth has some kind of a railway. The larger and more important countries have an elaborate network of railways linking every town. These railways carry goods.

The very first railways that were built were constructed to enable the coal produced at the collieries to be transported rapidly to the factory towns or ironworks. The idea of carrying passengers was an afterthought.

For almost a century railways had the carrying of goods and passengers all to themselves. If people wished to travel they must go by train or walk, unless there was a coach that would serve. The coaches, however, rapidly gave up. Despite its discomforts, railway travel was cheap and easy. So the railways thrived, for there were no competitors. Each company was protected from competition by its own Act of Parliament.

The rapid growth of motor roads, however, has altered this. Not only has the new method of travel proved popular,

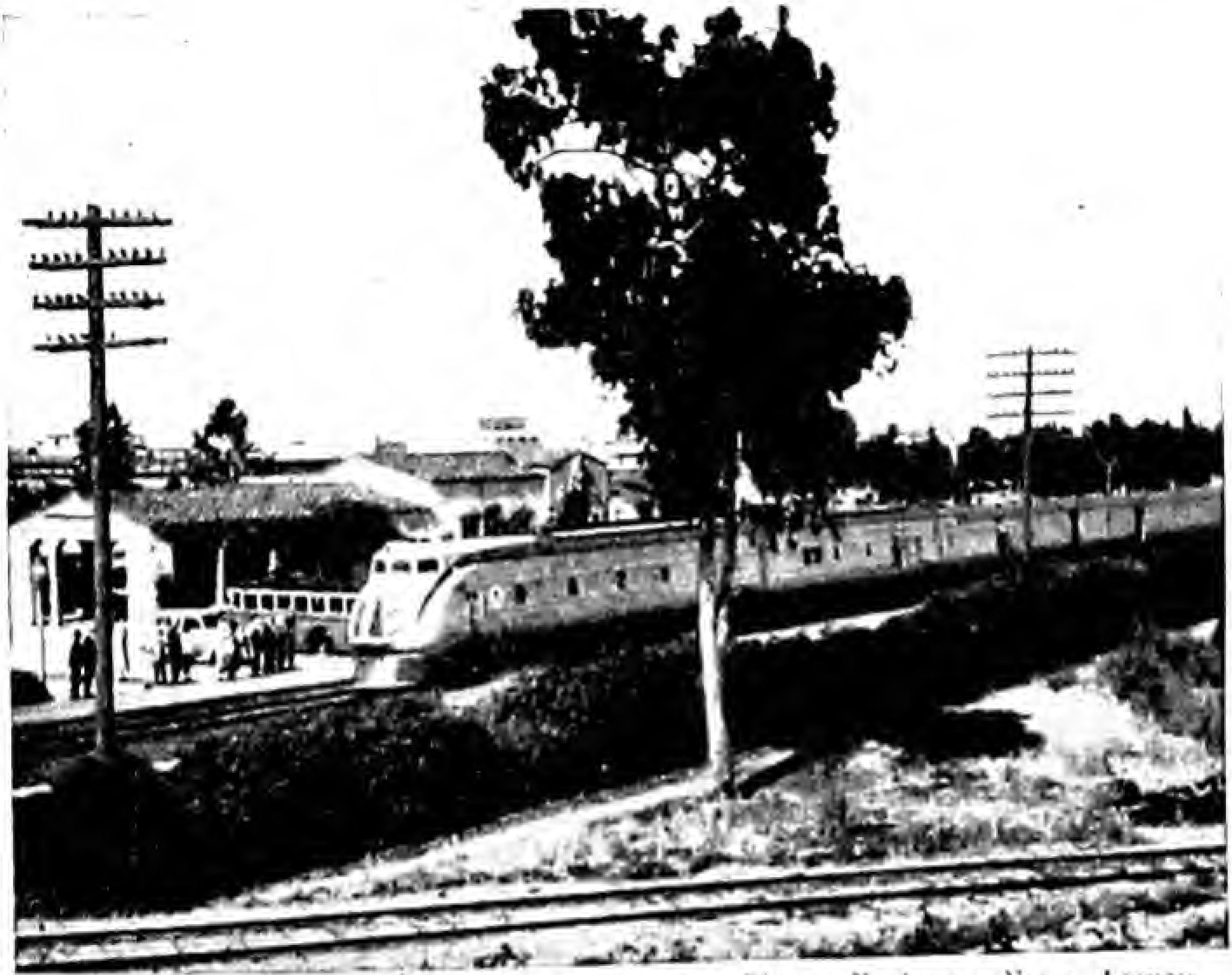


Photo: Exclusive News Agency.

A MODERN STREAMLINED FLYER.

This shows the "City of Portland," a Diesel-engined, six-car, streamlined express which runs between Chicago and Portland on the Union Pacific Railroad. This crack speed-train, complete with dining and sleeping cars, covers the 2,272 miles in thirty-nine hours, including crossing the Rockies. A train of this type holds the record for the fastest run across the North American continent between Los Angeles and New York. Here it is seen at a wayside station.

but it has robbed the railways of the business which was most profitable—that of carrying manufactured goods and moderate-sized packages. The railways have been left with the transport of minerals such as coal, stone, and ore, and heavy, bulky goods, all of which have to be carried at cheap rates. The cream of the traffic has gone to the roads, which run from door to door.

Despite this, the railways of the world are very important, for they provide a safe, rapid, and cheap means of

communication over long distances. They also provide the only means of transporting the bulk of the agricultural and mineral produce of the world to the places where it is needed. Rivers are bridged, mountain ranges are pierced by tunnels, great embankments are built, all to provide the railways with a fast level route.

Every country has its own main lines, while every continent except Antarctica (where there are no railways or people) is crossed by at least one great transcontinental line. Europe and North America have each many transcontinental routes. Railways are also necessary in big industrial towns and at the ports, where large quantities of goods have to be moved rapidly.

Thus the railways of the world are not likely to fall into disuse, but their purpose will be to act as the servants of the heavy industries.

AEROPLANES

Fast on the heels of the motor car has come the aeroplane. This, as a means of travel, has become a serious rival to both road and rail. For long distances the aeroplane is swift and comfortable. It needs no roads, no elaborately guarded steel route, but it can take its own road literally as the crow flies.

Every month sees an extension of the air routes of the world, for the cost is not much higher than that of first-class rail travel, while the time saved is immense.

From London, Egypt may be reached in a day, India in one and a half, Johannesburg and Singapore in two, Australia in four. Even the oceans are now crossed, and a regular air service is in operation between Europe and South America. A letter posted in London on Saturday reaches Buenos Aires on Tuesday. North America and Europe are criss-

crossed with public air services, many of which operate both by day and night.

The great advantages of the aeroplane are speed and comfort. Most of the regular services operate at speeds of from 120 to 150 miles an hour, while meals are served and telegrams may be dispatched and received while the machine is in the air.

The disadvantages are limitations of size and weight on goods to be carried. Goods of small bulk and of high value are the most suited for air transport. Jewellery, bullion, valuable fabrics and goods of this type are the ones most usually carried by air. At the same time these difficulties are not insurmountable, and the aeroplane has proved its value and usefulness even in the transport of heavy goods.

Recently a valuable goldfield was discovered in the interior of Papua, a large tropical island to the north of Australia. There were no roads, the only available river route was impassible owing to rapids and shallows, while between the coast and the goldfield was a high and difficult mountain range whose slopes were covered with impenetrable forest and jungle.

The problem that faced the would-be gold miners was how to get the heavy machinery needed for the mining from the coast to the mining area. The gold was to be obtained by dredging, as tin is mined in Malaya. Even if the machinery were dismantled the larger pieces would still weigh several tons.

There were three possible ways of getting the machinery to the goldfield. One was to build a railway (which would have been the only way thirty years ago), another was to construct a motor road, while the last, which seemed almost impracticable, was by air. The aeroplane won.

Two all-metal 'planes were used, and the machinery was

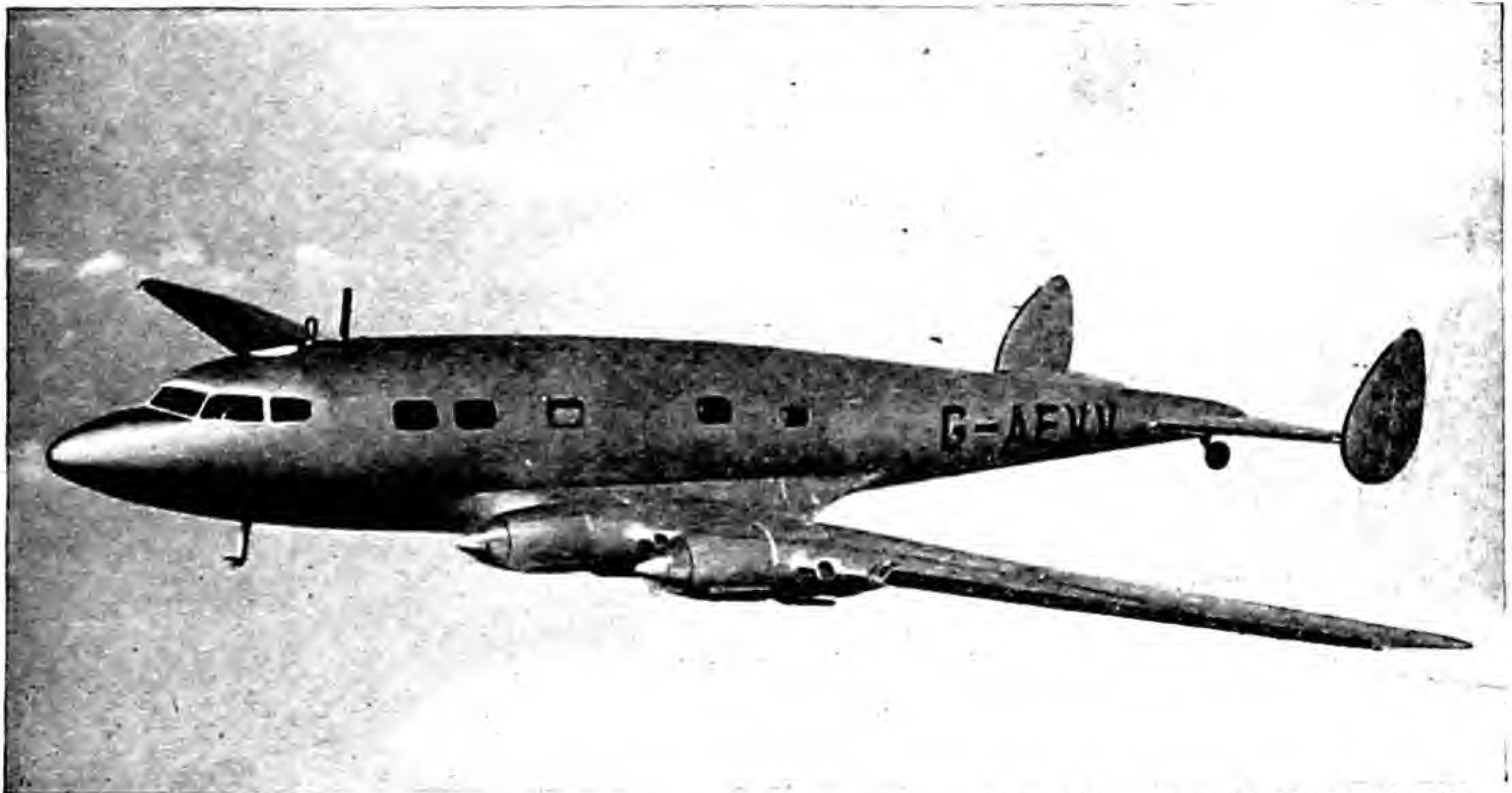


Photo: By courtesy of "The Aeroplane."

ABOVE THE ATLANTIC AT 200 M.P.H.

This De Haviland Albatross is specially designed for the trans-Atlantic service and for fast passenger transport. It has four engines, each of 525 h.p., and cruises at well over 200 m.p.h.

transported, piece by piece, to the lake where the dredge was to operate. Even the long arms of the dredge were successfully carried, and in less than a year the machinery was in operation. To build a railway would have taken three years, a motor road not much less. The same 'planes brought the gold back. They stood out of doors in all weathers, whether pouring tropical rain or intense heat, and the service has operated very successfully from the start.

In another corner of the world the aeroplane has also been of service to the gold miner. Several of the newly discovered goldfields in Northern Canada are only reached by air. The aeroplane has also enabled unknown tracts of the earth's surface to be surveyed and explored. The mysteries of the Amazon forests were first opened up by air, while parts of the Antarctic continent have been thoroughly surveyed in the same way.

Thus the aeroplane has been of very real use to Man in his development of the earth's surface, as well as assisting his ease of movement.

The most modern development of air travel is that of the amateur or private air-traveller. Many people now own their own aeroplane, and the time seems to be approaching when the small family aeroplane will be as common as the family car. Problems of landing and accommodation are already being solved. There are now in use aeroplanes which can rise almost vertically, and which have folding wings for ease of storage.

Large buildings in great cities are now designed with provision for a landing-place on the flat roof. In a few years' time it may be that Mr. and Mrs. Everyman will be able to keep their own aeroplane in a garage on the roof, and the roads will no longer be so congested.

SEA TRANSPORT

Although land transport is very important, it would not be able to operate if it were not for ocean trade.

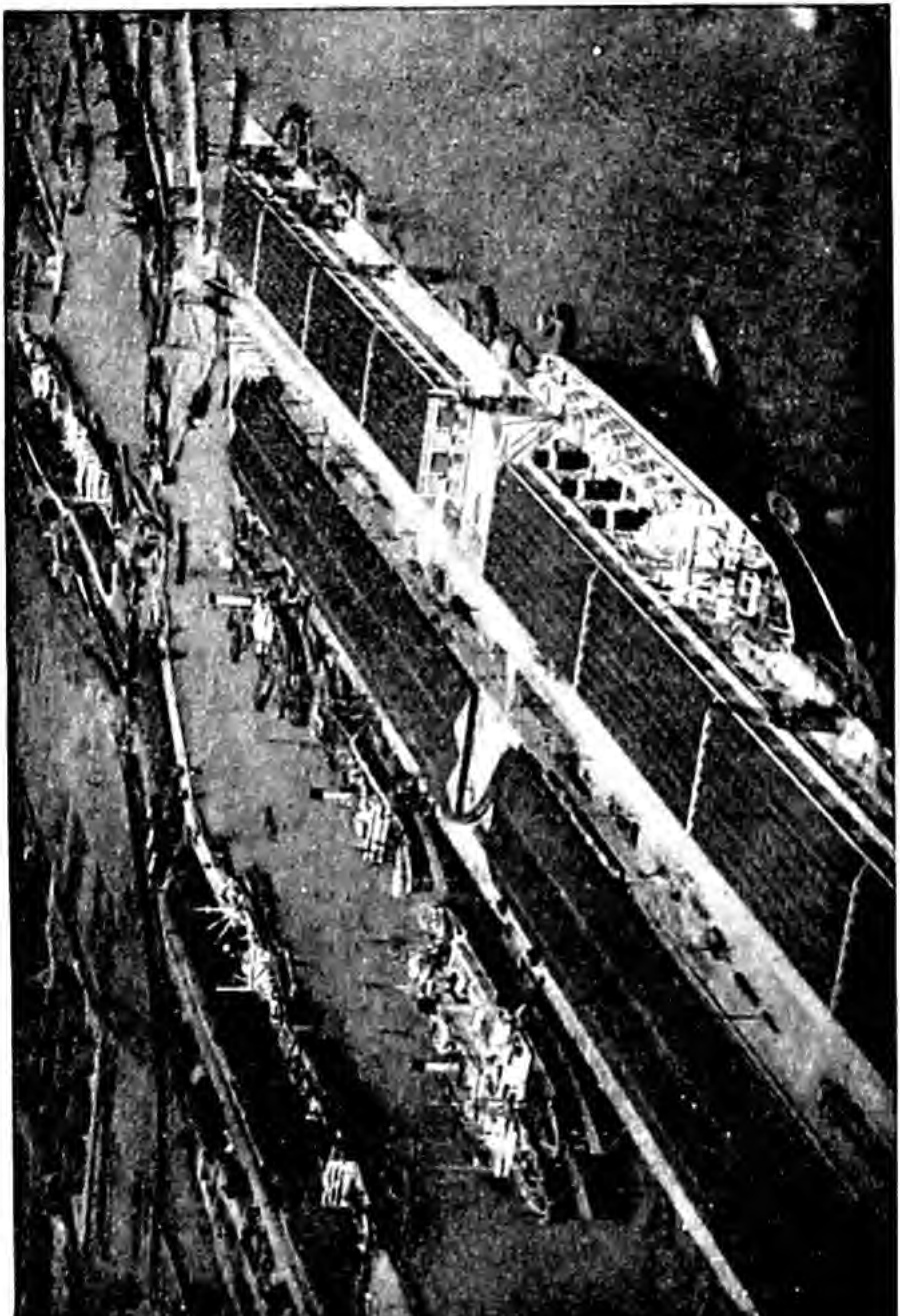
The sea has been the means of linking up the countries of the world, and to-day the oceans are crossed and re-crossed by huge vessels carrying thousands of tons of cargo at a time.

The development of ocean transport is not as old as that of land travel, for men could not venture out of sight of land until five hundred years ago. Nor were the tides and other dangers of the sea thoroughly understood. It was not until the mariner's compass was discovered, and a really reliable clock was invented that sailors were able to trust themselves on the open ocean.

Seamanship seems to have developed in four different regions of the earth. In the Mediterranean Sea, which is tideless, and where islands and peninsulas abound, it was fairly easy for seamen to find their way about. So the Phœnicians, and later the Greeks, became the seamen of the Western World. They were followed by the Venetians and the Genoese. It was a Genoese pilot who discovered America, and a seaman of Venetian parentage who first reached Newfoundland.

The Mediterranean sailors made use of the "galley," a long narrow ship that could be propelled by oars as well as by sails.

About the same time that the Phœnicians were exploring the Mediterranean in search of tin and copper, the Arabs along the coasts of Arabia and the Persian Gulf were also undertaking long voyages. They were helped in this way by the regular monsoon winds, which blow across the Indian Ocean first in one direction and then in the other. These winds are not only regular, but blow parallel with the coast



PART OF KING GEORGE V. DOCK, LONDON.

of Arabia. Thus the early Arab seamen could reach Africa on the North-East or Winter Monsoon, and return or even continue to India on the South-West or Summer Monsoon.

To accomplish their voyages they used a squat, broad boat called a dhow, with a large triangular sail. The single sail was so arranged that it could be raised or lowered rapidly without a great deal of effort. To-day the dhows still cross the Indian Ocean in their thousands.

By the end of November, the North-East Trades, strengthened by the outgoing winter winds of India, are blowing strongly towards the African coast, and from the Gulf to Colombo, in every port from Muscat to Calicut, hundreds of picturesque Arab and Persian craft, differing but little from those of Solomon's day, set sail and make for Africa and Zanzibar.

It is a matter of 2,000 miles, but these modern descendants of the sailors of Sheba think little of it. It is a regular event in their lives. They hoist their tapering sails, and by the end of the year as many as two to three thousand dhows have reached Zanzibar. On arrival, the crews don their gayest clothing, roaming the streets of the old city in coloured silks, with gleaming silver-handled swords and daggers in their sashes. Of old, they would have been slavers or pirates, but now that the Union Jack flies over the Protectorate they must perforce be traders. So now, where slaves and plunder once changed hands, the new-comers gladly exchange their dates and spices, coffee and oranges, rugs and carpets, for the flour, timber, and calico from the West.

In February the bazaar is in full swing, and Indians of all grades may be seen doing their best to sell the visitor anything from a hammered copper pin-tray to a valuable Persian prayer rug. By the end of March the South-West

Monsoon begins to blow, and in a few days the dhows which are now crowding the harbour will be scudding home before the breeze.

A third coast land where seamanship developed was in

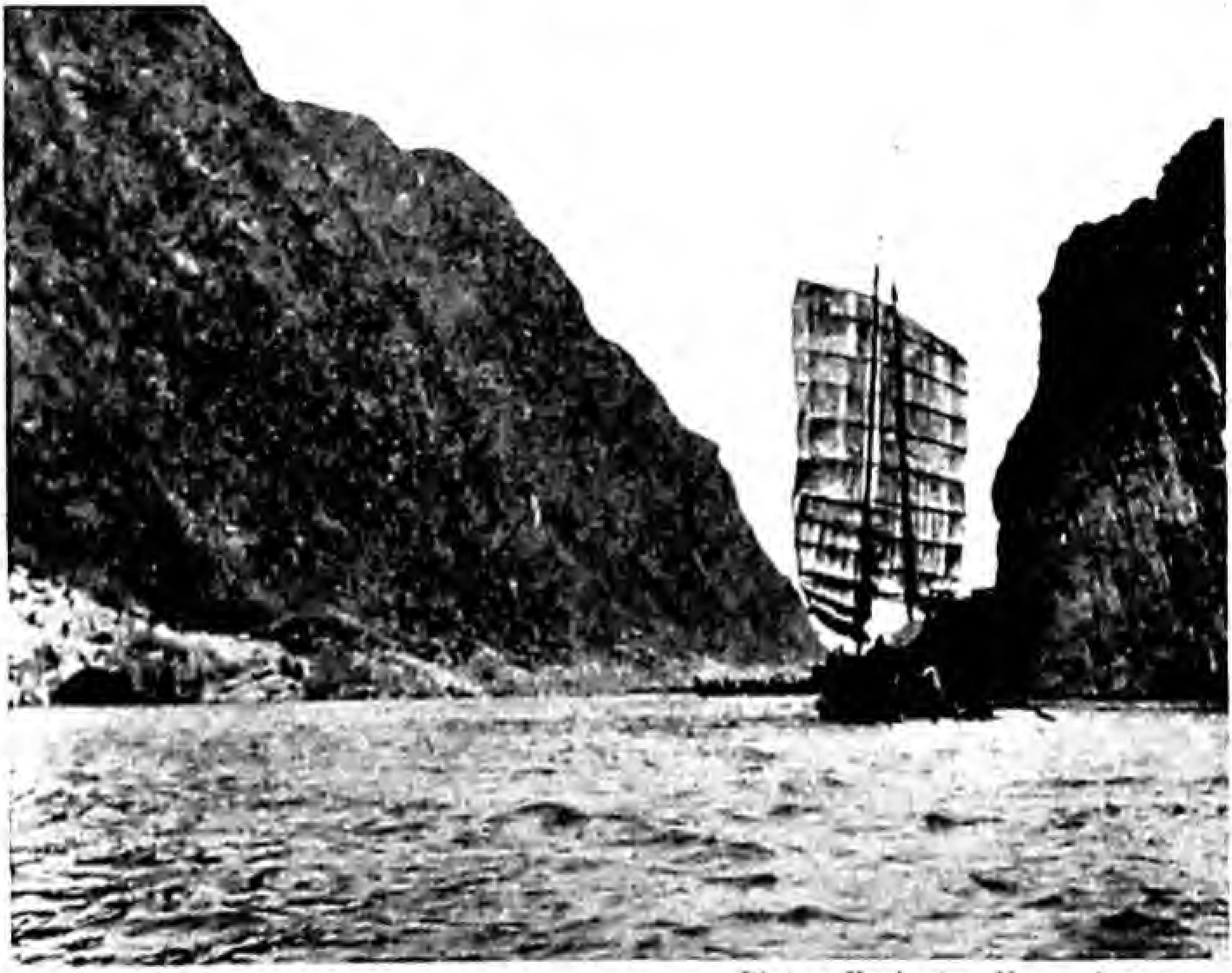


Photo: Exclusive News Agency.

A JUNK ON THE YANG-TSE.

In China vast quantities of goods are carried along the rivers and coasts in big, heavy, flat-bottomed junks, or in the smaller and lighter sampans. This junk, with its high matting sails to catch the lightest breeze, is navigating a bend in the famous gorges on the Yang-tse River, in Central China. These gorges extend for eighty miles above Ichang.

China, where the crowded river valleys were separated by forested mountains. The easiest way of travel was to go down the river, along the coast, and up the next river. But the rivers were very shallow at times and liable to flood at others. The only suitable boat was a flat-bottomed, square-

ended vessel with tall sides. This was the junk, the most clumsy craft that ever put to sea, and yet very suited to its purpose. It was propelled by sails made of strips of matting which could be raised or lowered like a blind. Altogether the junk is one of the most remarkable ships ever invented. It has not been altered appreciably during the many centuries of its use, and junks still throng the China seas as they did in the days of Marco Polo.

The last school of seamanship was in the narrow Norwegian fiords, where stern necessity and a barren inhospitable shore, drove men on to the water. Behind the long line of mountainous islands which break the force of the Atlantic storms, the Scandinavian seamen learned to handle their longships. They feared neither storm nor tide, and when at length they ventured in search of wealth they carried terror and destruction with them.

The fishermen of our north-east coasts of Britain owe their skill and seamanship to their Viking forbears. To-day, wherever ships go, there are found the rugged blue-eyed seamen of the north. The whaling industry of the world is still in their hands, and the opening up of the Polar Seas has been due almost entirely to their efforts.

To-day the trade of the world is carried on in very large vessels, which range in size from the 6,000-ton ocean tramp to the 80,000-ton Atlantic greyhounds. An average size for a cargo vessel is 12,000 to 14,000 tons. Such a ship uses from 40 to 60 tons of coal a day according to the speed, which is usually about 300 miles a day (twenty-four hours).

Modern ships are invariably made of steel, and have a double bottom, in which is a space that can be used for water ballast, or for oil fuel if it is an oil-burning vessel. There are several holds, each of which is reached from a separate hatchway. There is also refrigeration equipment,

to provide for carrying chilled or frozen meat, and each vessel is also fitted with gear for loading and unloading, so that the ship is not dependent upon cranes at a port.

Such vessels are built on deep-water estuaries near a coal-field where steel and machinery are available. Each country has its own shipbuilding ports, but British shipyards on

Photo: Mondiale.

THE SUEZ CANAL.

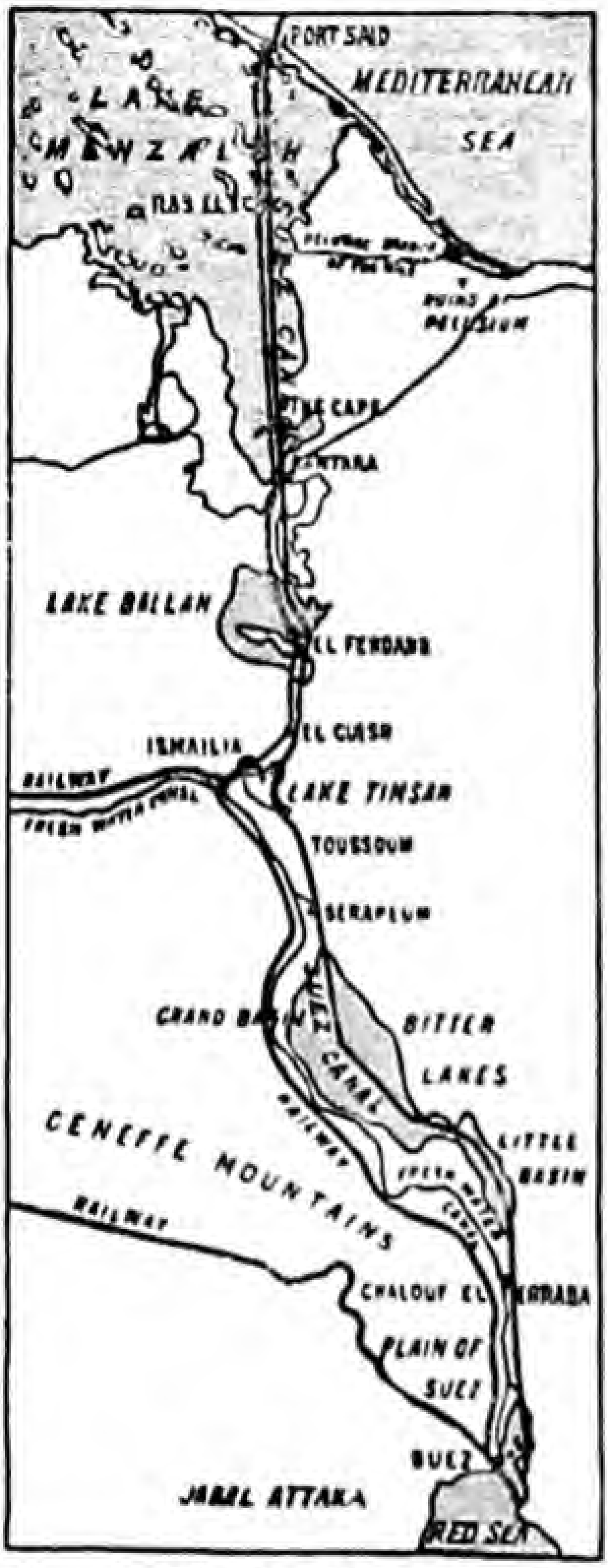
This great international waterway across the Isthmus of Suez is on the shortest sea-route between Europe and the East, and saves the long journey round Africa. The canal is 100 miles in length, and was opened in 1869. The time taken by vessels to pass through the canal is from 12 to 18 hours. More than one half of the number of vessels using the canal are British.

the Tyne, the Clyde, and the Mersey usually launch more ships than the whole of the rest of the world.

The size of an ocean ship is limited by the depth of the ports which it may have to use. Except for boats using the North Atlantic run between Western Europe and New York, few harbours have a greater depth than 30 to 35 feet at low water. It is therefore no use to build ships any

larger. The huge luxury liners on the Atlantic route, though much larger, do not draw over 40 feet of water.

All ships are necessarily dependent upon supplies of fuel, whether coal or oil. If long journeys are undertaken, part of the cargo space may have to be taken up by fuel unless the ship is going to call at a refuelling point. For reaching Australia from Britain a vessel would use 2,000 tons of coal. It is therefore easier to carry sufficient coal to last to Port Said, and to refuel there. The bunkers may also be refilled at Colombo. Thus an extra 1,000 tons of cargo may be carried.



The Suez Canal.

Shipping routes are dependent upon these coaling stations. They also depend upon the amount of cargo that is available at various ports. In order to shorten the distance on certain routes, large ship canals have been cut. The busiest of these is the Suez Canal between the Mediterranean and the Red Sea. It is about 100 miles in length from sea to sea, and is cut across a low, sandy isthmus, much of which is actually below sea-level.

The canal is 36 feet deep, which is as deep as most of the big harbours on the routes which it serves. It is a little over

200 feet in width, but wider at the curves. The passage through the canal normally takes about sixteen hours, for the speed of ships must be limited as the banks are very soft and sandy, and the wash from a fast ship would wear them away.

Dredging is always going on, and the canal is gradually being widened and deepened, until it is wide enough for the two largest ships which may be using the Far Eastern harbours to pass one another in safety. At the northern entrance is Port Said, now a busy port with depots, coal dumps, oil stores, and great repairing sheds. Not far away is Port Fuad, a garden city on the other side of the canal, built to provide homes for the people employed by the canal company. At the southern end is Suez, which is also a busy port.

The canal was constructed by a French company under a permit from the Khedive of Egypt, who received a certain number of shares. The British Government afterwards bought these shares and therefore owns a controlling interest in the canal. Nearly two-thirds of the shipping using the canal is British, and nearly one-third of the passengers carried through are troops or Government officials. The canal was opened in 1869, and is open to the ships of all nations. It is on the shortest and busiest route between the great industrial countries of Western Europe and the crowded lands of the Far East. The canal saves 4,000 miles to India, 2,000 to Singapore, and 1,000 to Australian ports.

The Atlantic and Pacific Oceans are linked by the Panama Canal, which cuts through the isthmus between North and South America. This canal is wider and deeper than the Suez, and although only half as long, has a series of locks.

The Panama Canal was commenced by a French company similar to that which constructed the Suez, but the engineering difficulties were immense. The canal also lies within the

Tropics, and the area was very unhealthy, so that the workmen died by thousands. The enterprise was therefore abandoned, but the American Government took it up many years later and at tremendous expense completed the canal in 1914.

The canal has been cut at a point where the mountain

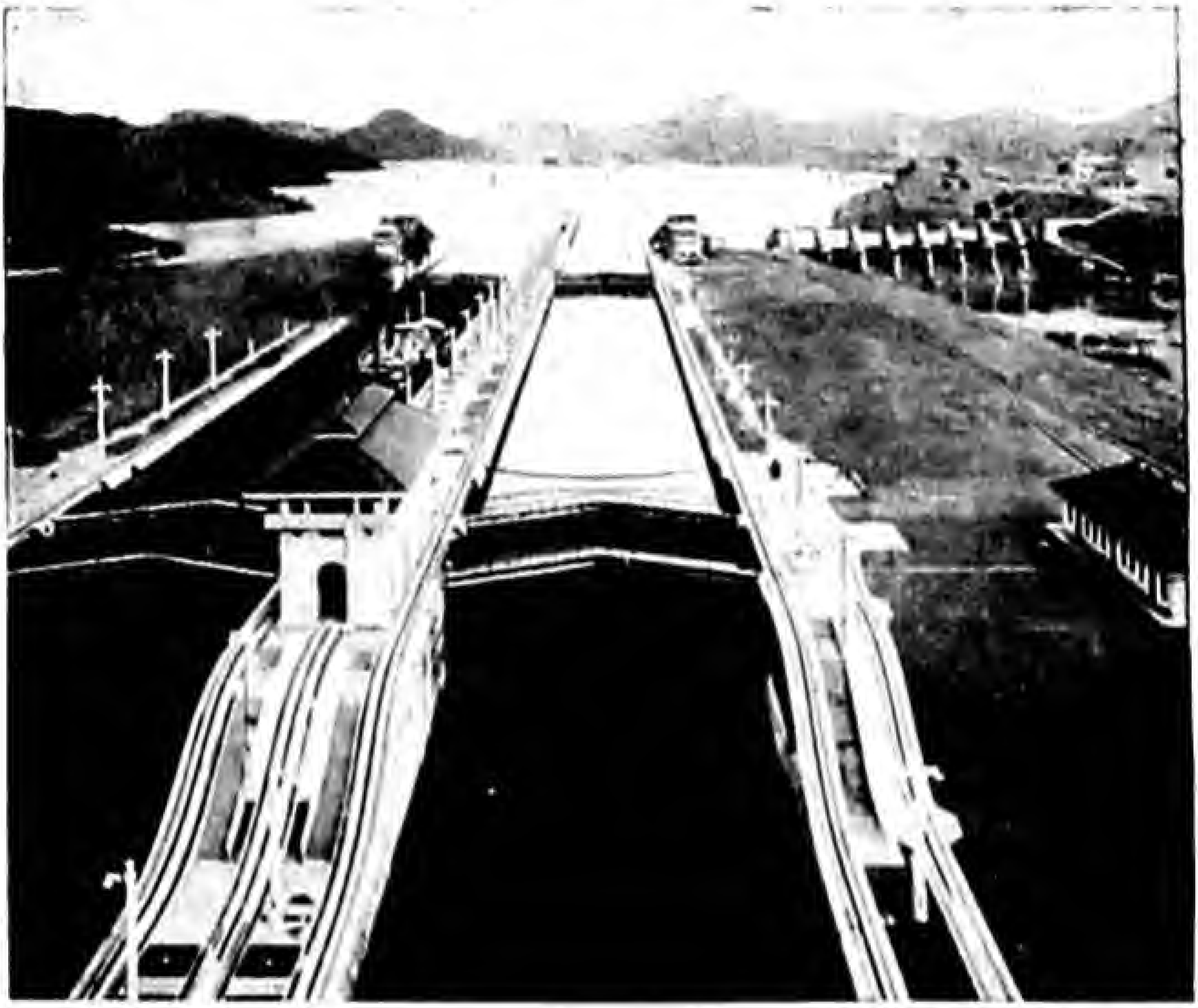


Photo: Ewing Galloway.

THE PANAMA CANAL.

The Panama Canal is cut through a hilly isthmus. This lock, the Miraflores Lock, is one of three to enable vessels to be raised or lowered from the central section of the canal, which is 90 feet above sea-level. The canal is 50 miles in length, and was opened in 1914. The time taken to pass through the canal is from seven to eight hours. About one-quarter of the ships using the canal are British.

backbone of the isthmus sinks to a low range of hills. Here only eight miles separate the valleys of two streams, one of which, the Chagres, flows into the Caribbean Sea. The other, a much smaller stream, flows into the Pacific. Briefly, the plan followed by the builders of the canal has been to put a

dam across both streams, thus raising the level of the water on either side of the ridge, which was then cut through by a narrow channel joining the two artificial lakes. A single lock on the Pacific side completes this central section, as the difference in level between the two lakes is considerable. Access to the central portion of the canal is gained by locks leading from the lower sea-level section on either side.

The Panama Canal.

The central portion of the canal, including the Gatun Lake, is 85 feet above the level of the Caribbean Sea. The canal is 300 feet wide at the bottom at its narrowest part and 45 feet deep. The size of vessels is limited by the width of the locks, but in 1933 a British battleship, the largest in the world, successfully "threaded the needle" with a few inches to spare on either side. The canal is amply large enough for all commercial vessels.

The Panama route is of the greatest value to the United States, saving as it does the long and difficult journey round Cape Horn. It is also of great value to Britain. About 5,000 to 6,000 miles are saved between Britain and the Pacific

coasts of both North and South America. New Zealand is 1,500 miles nearer. China and Australia can still be reached most easily via Suez. The great route by which the canal is approached from the east is through the Windward Passage, between the islands of Hispaniola and Cuba. This route is dominated by Jamaica, which has not only increased in strategic value, but has benefited considerably from the increased trade which passes its doors.

With the increase in the size of ships the trade of the world tends to be handled more and more by the larger ports, which can not only accommodate big ships but can provide rapid facilities for loading or unloading. These larger ports are served by many lines of smaller steamers which collect goods from the smaller ports and carry them to the big ports for transfer to the larger ships.

Thus the large ports of the world have all become " entrepôts " or exchange points. As the depth of their harbours is limited it is not likely that there will be any great increase in the size of ships using them. Moreover, the cost of large ships is very great and the expenses of working them are also considerable. It is therefore more economical for shipping companies to run moderate-sized vessels such as are in general use to-day.

CHAPTER XVII

THE WORLD TO-DAY AND TO-MORROW

WE are now in a position to get a better idea of how Man is utilizing the earth in which he lives. With the aid of machinery everything can now be done on a very large scale. The farmer can cultivate thousands of acres instead of hundreds, the factory can turn out things by the million, and by the aid of mechanical transport food and goods can be carried rapidly and cheaply to the people that use them.

The varied resources of the world are more than sufficient to provide for the needs of all its peoples. As year follows year, these resources are being more and more developed. The parts of the earth which are most suited for producing food crops are being given up more and more to the production of these. Industrial areas which make goods, clothes, and machinery now make these things for the markets of the world. Each part of the earth is becoming more and more dependent upon the rest.

This has resulted in the growth of enormous cities. Where power and raw materials are available, factory cities spring up. Where great trade routes meet or cross one another, commercial cities develop. The only people of the world to-day who live in villages or small towns are the farmers in the great agricultural districts, whether in Europe, America, or Australia. In fact, in Australia, three out of every four

Photo : Topical.

A MODERN CITY—NEW YORK.

Each of these skyscrapers houses as many workers as a small town.

people live in a big city. In New South Wales, an area two and a half times the size of the British Isles, over half the people live in Sydney.

This habit of crowding into big cities is growing, and it is having very serious results upon the life of the world, for city dwellers usually have only one job. They may be "hands" in a factory, or clerks in an office, but they are really only cogs in a gigantic machine. So long as the machinery is moving smoothly all goes well.

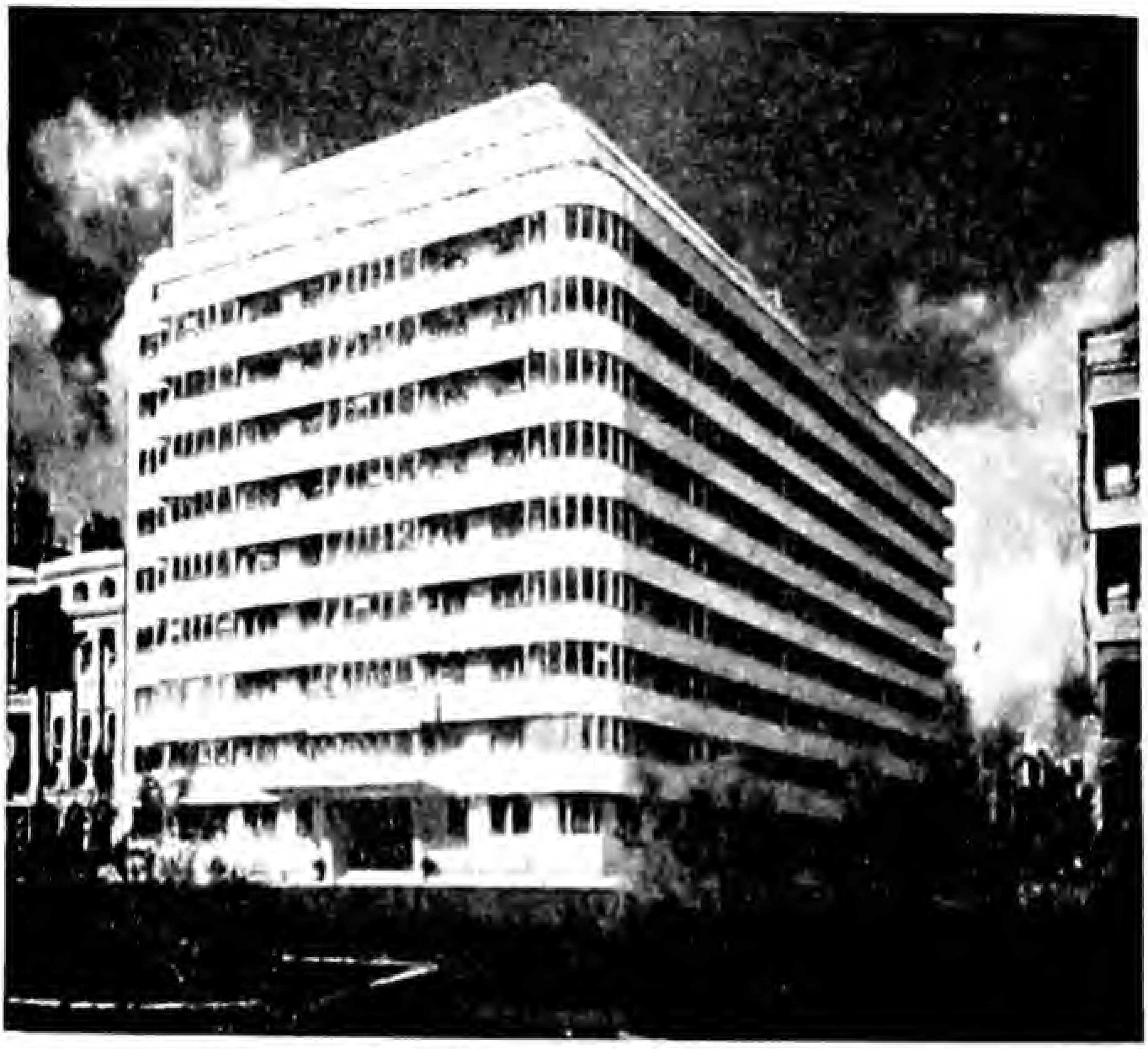
Unfortunately, the machinery does not always work smoothly. It may have to slow down because it has been going too fast. If people cannot buy goods it is no use making too many. If the farmer cannot sell his corn it is no use going on growing it. The worker in the world to-day is very much dependent upon the system of which he forms a part.

The result is that if anything happens to upset the smooth working of the world's business, thousands of people may suffer from it, and it takes a long while for things to get right. In Britain, and in a few other countries, this has been recognized, and workers are compelled to place a small portion of their earnings in a fund to provide for meeting the hard times that occur now and again.

We might ask ourselves whether this could be avoided; whether it would not be better for people to live in smaller cities and for more people to live "on the land." You will probably read or hear of such schemes, for the problems which face the people of the world are very real.

The fact is that the vast majority of people like living in towns or big cities. It is not merely that it is convenient for their work, but the life of a city or town offers attractions which the countryman can only obtain with difficulty.

Indeed there is little doubt but that the vast masses of coloured farmers in Africa or India remain in their villages



EMBASSY COURT, BRIGHTON.

Large blocks of flats such as these are becoming increasingly popular in modern cities. Gas, water, electricity, telephone, and heating are provided for each set of rooms, while there is usually a restaurant, library, and other amenities for the residents.

largely because they are ignorant of the attractions of town life.

The opening of the great copper mines of Northern Rhodesia and the Congo has resulted in remarkable changes in native life. Large numbers of native labourers are needed at the mines. At first the companies had to send lorries to recruit workers from the villages, and had to promise to take them home again after six months. Now it is harder to keep the natives away from the mines than to fetch them.

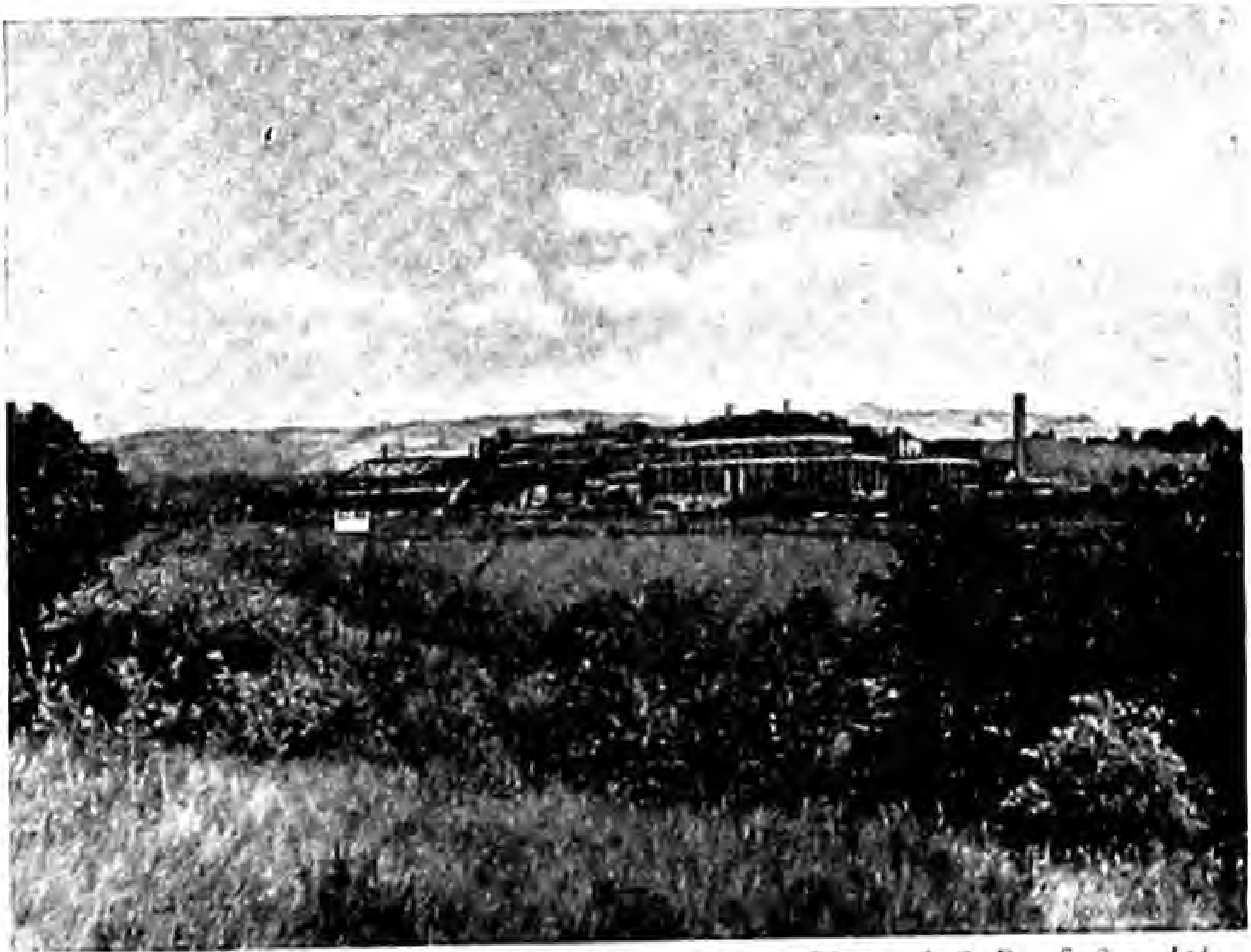


Photo: J. S. Fry & Sons Ltd.

A FACTORY IN A GARDEN.

Fry's factory at Somerdale, near Bristol, is situated in beautiful country and surrounded by playing fields. Here cocoa and chocolate are manufactured under ideal conditions, while the workers live in well-built modern houses in a garden city estate near the factory. Other famous firms, such as Lever Bros., at Port Sunlight, Cadbury's at Bournville, near Birmingham, and many others, also have their works established in similar healthy and pleasant surroundings. It is not necessary for factories to be enclosed by slums.

Every week a constant stream of natives is making its way towards what is, to them, Eldorado. Some go on foot, others on bicycles, while those who can afford to do so travel by lorry. These are the plutocrats. They have been before.

Behind him the native leaves the quiet peaceful life of a village, a life that glides leisurely with the seasons—fishing, hunting, clearing the bush for gardens, reaping the grain, drinking home-made beer, and having a capable wife to work for him. In front of him lies a life of comparative drudgery.

He must work hard for a stated number of hours ; there are few holidays ; he surrenders his freedom in return for a job, which, while it lasts, provides him with a certain amount of money.

He may, and often does, return to his village for a time to pick up the old peaceful life, but, sooner or later, back he goes again to labour in the mines, or, if there is no work, to become a hanger-on. Why does he do it ?

The answer is simple. A new world is opened up to him, and with it the possession, if only for a few hours, of money ; and money that will purchase unheard-of delights. He can buy clothes like the white man. He can gaze at the windows of the native shops in the mining town, and if he has sufficient money he can purchase anything he fancies.

At home he has to share with everyone else in the village, just as centuries ago in an English village everyone had to share. At home money has no value. It would purchase nothing. If he wishes to eat he must eat with his relatives.

At the mines he can order a meal and eat it all by himself. He can drink as much beer as he has money to pay for. His wife finds the life easier too, for she can buy food ready prepared, flour ready ground, and far more attractive clothes (from her point of view) than the rough native-made cloth of the village.

And so the African light-heartedly throws away his freedom to become a cog in the machine.

What is happening to the African native is also happening, if to a less extent, all the world over. The mining camp becomes a town, shops are opened, a cinema is built, other amusements follow, and city life begins to develop.

With the building of large numbers of houses other problems have to be faced. Water, drains, electricity and gas are needed, and a postal service has to be organized.

These things need careful planning. In most of the cities of the Old World such things have come about in a very haphazard way. Streets may be narrow and winding; factories may have been built at awkward points; many of the houses

Photo: Exclusive News Agency.

A MODERN FACTORY.

Along the Great West Road outside London are lines of modern factories, of which this is a splendid example. There are no sooty chimneys, or badly-lit, crowded workrooms. The building is of concrete and glass. Electric power, which is clean and silent, is used, and the factory is not hemmed in by slums. There is plenty of light and air, making for healthy conditions.

may be crowded together so that their occupants do not have sufficient light and air.

In America, where cities have been built within the past thirty years, all these things were planned ahead. Streets run at right angles to one another and are wide enough to allow for future traffic needs. Buildings are also controlled

in size and shape and in design. Ugly buildings are not permitted. Factories are only permitted in certain districts. Other parts of the city are reserved for houses or shops, or even for a theatre or a church.

In Britain this planning is now also being followed, and new roads and new buildings are very carefully controlled. Meanwhile as old buildings are worn out they may be pulled down to make more room. Streets are widened by buying up the property on either side, pulling it down and rebuilding.

Owing to the immense size of modern cities, land there becomes very valuable. This leads to tall buildings being erected. In America they are called skyscrapers, and may be seven or eight hundred feet in height. Such large buildings are almost always offices or banks rather than factories, for it is not convenient to operate heavy machinery too far above the ground.

At present the city workers live where they can—usually in "dormitory" suburbs around the city—and travel to their work by car, bus, or train. Hotels and restaurants provide food and accommodation for them.

In the city of to-morrow provision will be made for all these matters. The heart of the city will be the civic centre—a spacious city hall, offices for the work of running the city services, a library, art gallery, and possibly even a university college.

Around this will be grouped large blocks of office buildings, banks, insurance offices, some of which will have public restaurants on their ground floor. Beyond these will be a ring of shopping boulevards—wide streets lined with big stores, hotels, and theatres or cinemas.

Outside this shopping area, wide avenues lined with trees lead outwards towards the country, and linked by cross

streets on either side of which are the homes of the city workers. On the main avenues at intervals are large blocks of flats, each with its own restaurant and library. Between these are open spaces laid out as public parks, with tennis courts and sports grounds. Between the main avenues, and away from the noise of traffic, will be the churches and chapels or meeting houses.

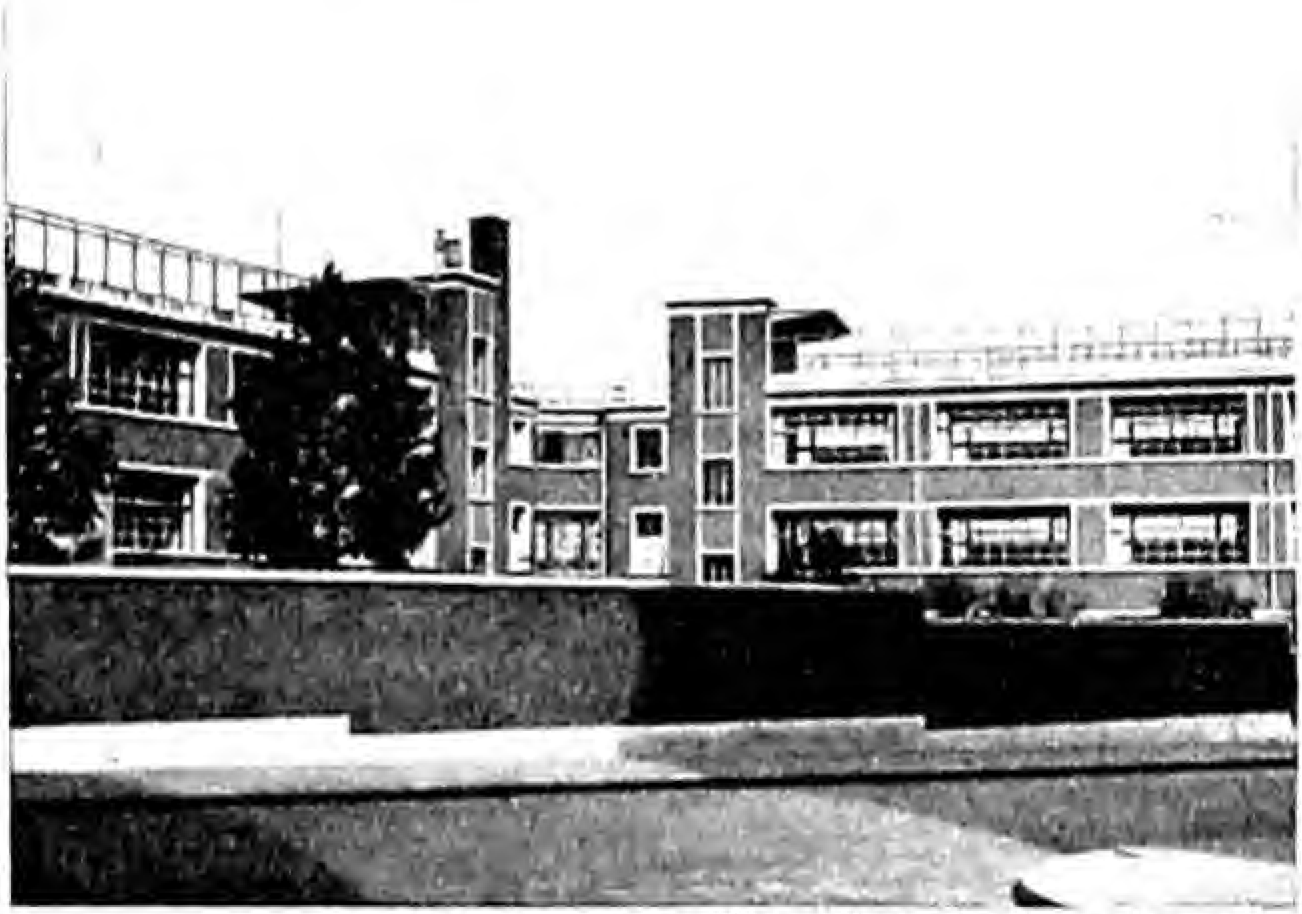


Photo: Exclusive News Agency.

A SCHOOL OF TO-DAY.

The schools of to-day have plenty of light and air. This is a school in Paris.

On the outskirts of the city, served by the great commercial roads, are the factories, while the important avenues continue as motor-ways to other cities. Many of the houses in the residential suburbs will, like the offices and flats, have flat roofs for the accommodation of aeroplanes. Railways will only serve the factories, but the larger cities will be encircled by an underground electric railway service serving

the residential districts, each quarter of which will have its own shops, branch library, and post office.

Cities will be linked to one another not only by road, rail, and air routes, but by wireless telephone.

All of these things are already in operation. No city yet possesses all of them, but the cities of the western world are slowly moving towards this goal. The devastation of the crowded parts of the older cities of Britain during the war has provided an unexpected opportunity for many of these improvements to be carried out, and it is likely that the new cities which will arise from the ashes of the old will conform to a greater or less extent to these ideals.

Outside the cities the farmer, aided by electric power, will go in more and more for what the Americans call "truck farming," to supply the city dwellers with the milk, fruit, vegetables, and meat that they need. All of these will be handled by big firms that collect the produce from the farm and deliver them to the shops and stores in the cities.

Such may be the world of to-morrow.

QUESTIONS AND EXERCISES

CHAPTER I

1. What are the chief necessities of everyday life? Which do you consider the most important, and why?
2. Write a brief description of the daily life of the blackfellows of Australia.
3. Give as many examples as you can of the way in which houses are built in different parts of the world, mentioning the materials used and the reasons for their selection.
4. Mention various ways in which men clothe themselves in different parts of the world, and give reasons for the differences.
5. What are the chief differences between pastoral peoples and agricultural peoples in their way of life?
6. Read carefully the story of a tin of salmon and then write the story of one of the following: (*a*) a cup of tea, (*b*) a pair of shoes, (*c*) a loaf of bread, (*d*) a reel of cotton. Use the Index to obtain the facts for your story.
7. What are the nine great classes of workers who supply our daily wants?
8. Why are farming peoples naturally peaceable while herdsmen are often warlike?
9. Explain the origin of landlords and rent.
10. How is it that a war between nations affects daily life all over the world?

CHAPTER II

11. Name the three great types of farm land, mentioning where the chief areas of each type are found. Why is it that only a small part of the surface of the earth is farm land?
12. Mention the three important kinds of farming carried on by mankind, giving a brief description of each.

13. Using the map on page 20, write a short account of the way in which the land is used (*a*) in the north of Canada, (*b*) in the Rockies, (*c*) on the coast of the Gulf of Mexico. Give reasons in each case.
14. Mention several ways in which farmers have been helped to improve their crops.
15. What is meant by "rotation of crops"? If you live in the country choose a particular field near your home and find out what crops have been grown upon it for the past six years.
16. Mention the principal machines used by a modern farmer, and say what each is used for.
17. What is a "combine"? Why are combines not used much in Britain?
18. Using the picture on page 18 and the Index, describe the work of a cotton farmer. What other farm crops are grown in the tropics?
19. Contrast the ways of ploughing that are illustrated on pages 11 and 23.
20. How does marketing help the farmer? Give a simple example.

CHAPTER III

21. What is the best kind of climate for the cultivation of wheat, and explain why?
22. Where are the chief wheat lands of the world? Insert them on a blank map and name them.
23. Describe how North American wheat is marketed.
24. Make a summary of the chief wheat lands of the world in a table, showing against each (*a*) the time of harvest, (*b*) the chief port or ports from which the wheat is exported, (*c*) the approximate time taken for the wheat to reach Britain.
25. What are the other cereals besides wheat? Mention what each is used for.
26. Where are the monsoon lands? Write a short account of their climate.
27. Which is the most important maize-growing area in the world? What is a great part of the crop used for?
28. Which country supplies most of the rice imported into Britain? Write a brief description of how it is cultivated.

29. Look for a Grain Market Report in a daily paper, and mark the districts mentioned on a blank map of the world. Show the routes by which the grain may reach Britain. (If you cannot find a Report for yourself, use the one given on page 39.)
30. Write a brief account of the wheat lands of the Empire.

CHAPTER IV

31. Why is dairying an essential occupation in the life of a civilized nation?
32. What is the most suitable climate for dairying? In what parts of the world is such a climate found?
33. Compare the climates of Copenhagen and Auckland.
34. On what are dairy cattle fed in winter in lands where they cannot find food out of doors?
35. Using the picture on page 46, write a brief account of dairy farming in Denmark.
36. Why does Holland produce cheese while Denmark produces butter?
37. Why is bacon an important product in dairying areas?
38. Write a brief account of dairy farming in Switzerland, using the picture on page 50.
39. Describe a day in the life of a dairy farmer.
40. What factory products are made out of milk besides butter and cheese?

CHAPTER V

41. Make a summary of the chief wool-producing countries of the world in a table, showing against each (*a*) the chief exporting ports, (*b*) the approximate time taken for the wool to reach Britain.
42. What kind of climate is most suited for sheep, and why?
43. Why is mutton produced in New Zealand and Argentina, but not to any extent in Australia or South Africa?
44. Describe a day in the life of a shepherd.
45. Write a short essay on "Round the year on a sheep farm."
46. Give an account of shearing on an Australian sheep station.

47. What route is taken by sailing-ships bringing wheat or wool from Australia to Britain, and why? By what route do they return, and why? (Study a map of the winds of the world for this question.)
48. Draw a map to show the chief wool-producing districts in Australia, naming the inland centres and the ports.
49. Using the graphs on pages 43 and 62, compare and contrast the climate of North Island and South Island, New Zealand.
50. Why is wool so useful to people living in the cooler temperate lands? What advantages has it over cotton, linen, or silk?

CHAPTER VI

51. What are the main differences between dairy farming and cattle rearing?
52. Describe the life on a ranch in North America. How is it changing?
53. Write a short account of the meat industry of Chicago.
54. Which is the chief cattle-rearing area in Australia? What difficulties does the Australian cattle farmer have to face and how are they being overcome?
55. Why is Argentina the most important beef-producing country in the world at present? Illustrate your answer with a sketch-map.
56. What is the best kind of climate for rearing beef cattle? Mention the chief cattle-ranching areas of the world.
57. Write the story of a joint of Argentine beef.
58. Write the story of a joint of English beef.
59. Give a brief description of how leather is manufactured. Mention the chief uses to which leather is put.
60. Using the map on page 71, write an account of cattle farming in the British Isles.

CHAPTER VII

61. Make a list of the purposes for which water is needed in a modern town.
62. Give a short account of how water is supplied to your own town or village. How much water is used on an average by each person per day?

63. How does brewing provide work for the farmer? What materials are used and which of the grains mentioned in the Grain Market Report on page 39 are likely to be bought by brewers?
64. Write a short account of tea-growing, mentioning the climate, soil, and cultivation. Which are the chief tea-producing countries of the world?
65. Give some account of the production of cocoa, mentioning the conditions needed for its successful cultivation and the chief cocoa-producing countries.
66. How is coffee cultivated? Which part of the world produces the most coffee? and describe the conditions under which the coffee is grown there.
67. On a blank map of the world mark in the chief producing areas for tea, coffee, and cocoa.
68. How are mineral waters produced?
69. In what part of the world are the largest wine-producing countries, and why?
70. Copy the diagrams for the world output of tea, cocoa, and coffee (given on pages 87 and 89) and colour them.

CHAPTER VIII

71. What is meant by a Mediterranean type of climate? In what parts of the world does it occur?
72. What is meant by the "swing of the wind belts"? How does this affect climate?
73. Which are the most important fruits cultivated in Mediterranean lands and for what are they used?
74. Give some account of viti-culture (*i.e.* the culture of the vine).
75. Which are the chief orange-growing countries of the world? Give a short account of the tree and explain how the fruit is packed for marketing.
76. What are "citrus fruits"? Give some account of their production.
77. Write an essay on "Round the year on a fruit farm."
78. What kinds of fruit are grown in large quantities in (*a*) Canada, (*b*) South Africa, (*c*) Australia? Mention the chief producing areas in each case.

79. Give some account of the cultivation of tropical fruits which are grown for eating in temperate lands.
80. Why are transport and marketing very important to the fruit grower? Find out what special arrangements for rapid carriage and quick selling are made for fruit.

CHAPTER IX

81. Mention some of the ways in which primitive peoples still catch fish.
82. Using the picture on page 114, describe how an Eskimo catches fish.
83. What is a continental shelf? Why does a continental shelf provide good fishing grounds?
84. What kinds of fish live (*a*) near the surface of the sea, (*b*) near the bottom? Which are the chief fishing grounds of the world?
85. Describe a trip on a drifter.
86. Give some account of work on a trawler.
87. Describe the scene shown in the picture on page 120.
88. Write the life-story of a salmon. What happens to the salmon after it has been caught?
89. Mention the different ways of preserving or curing fish.
90. Write a few lines on each of the following: cod, oysters, anchovy, sturgeon.

CHAPTER X

91. Make a list of the industries that may be described as "food manufacturing."
92. Describe the work carried on in a machine bakery.
93. Which are the chief bacon-producing countries of the world, and why?
94. What is meant by food "going bad"? Mention some of the ways in which this may be hindered.
95. How does canning enable food to be preserved?
96. Why does refrigeration preserve food? What is the difference between freezing, chilling, and cold storage?
97. Why do certain kinds of food keep better if they are dried? Give as many examples as possible.

98. What kind of a room serves best as a larder, and why?
99. Make a list of the foods in the cupboard at home which have been preserved in one way or another. Against each write the method that has been used to preserve it.
100. Why are food-factories better situated if they are in "garden cities" rather than in the middle of crowded towns?

CHAPTER XI

101. What is the difference between linen and cotton? Give examples of the uses to which each is put.
102. Give some account of the cultivation of flax. Name the most important flax-producing countries.
103. Using the picture on page 143, write a description of a linen mill. Which are the chief linen centres of Britain?
104. Using the diagram on page 148, explain why cotton is manufactured in Lancashire.
105. What are the chief climatic requirements for the cultivation of cotton? Name the parts of the world where cotton is an important crop.
106. Write the life-history of a silkworm.
107. What advantages does silk possess over other fabrics? Name (*a*) the chief areas for the production of raw silk, (*b*) the chief centres for manufacturing silk.
108. What is artificial silk? What is it made from, and what are its advantages?
109. With the aid of a map explain where jute is grown, and give its principal uses.
110. What is sisal? Give a short account of its cultivation and use.

CHAPTER XII

111. Make a list of the chief materials used in house-building. Against each write down a district or place from which that material may have been obtained.
112. What is the difference between hard woods and soft woods? Give examples of each and the uses to which they are put.

113. On a blank map of the world insert the chief areas of forests outside the tropics. What kind of climate seems to favour the growth of temperate forest ?
114. Write the story of a door made from Columbia pine.
115. What are the chief differences in lumbering as practised in (*a*) Western Canada, (*b*) Eastern Canada, (*c*) Soviet Russia ?
116. What do you know of the following woods ? Mention where each is produced, its special qualities, and the purposes for which it is used : mahogany, jarrah, teak, oak, pine.
117. What is meant by deforestation ? Mention the results of deforestation and explain the benefits to be obtained by afforestation.
118. Mention at least two manufactured products that are obtained from trees or made from wood. Give a short account of how each is manufactured.
119. Why is stone used in some districts and brick in others for the walls of houses ? Mention the chief materials used for roofs and explain their advantages or disadvantages as the case may be.
120. What is cement ? How is it used in building ? Why is the present time sometimes called the "concrete age" ?

CHAPTER XIII

121. Where are the principal deposits of iron ore in the world ? What is also needed for the production of steel ?
122. Give some account of the Minnesota ore-fields of North America, and trace the movement of the ore until it finally reaches the blast-furnaces.
123. Explain, with the aid of a diagram, how a blast-furnace works.
124. Name the chief European centres for steel production and, with the aid of a sketch-map, give some account of any one of them.
125. Where are (*a*) the chief iron-mining areas, (*b*) the chief steel-making centres in Britain ? Explain why they are not, in most cases, the same.
126. What is the difference between Bessemer steel and "open-hearth" steel ? For what is each used ?

127. Write a few lines on each of the following: Campine, Soo Canals, Black Country, Hunter Valley, Broken Hill.
128. Give some account of the world supplies of (*a*) copper, (*b*) lead. Illustrate by a map of the world, showing the producing areas.
129. How is tin mined? Which are the chief producing areas of the world?
130. Choose some simple metal article used in everyday life and write its story from the mineral ore to the finished article. (Suggested articles: brass door-knob, steel pen-nib, table-spoon, safety razor and blade.)

CHAPTER XIV

131. Why is power necessary for our modern life? What power is used in lands where there is no coal, oil, electricity, or water power? Give examples.
132. What advantages has electricity over steam power?
133. Explain, with the aid of a simple diagram, how water may be used to drive machinery to generate electricity. Where are there such power stations in Britain?
134. What is meant by the "electricity grid"? What are its advantages? Which is the power station on the grid nearest to your home? Draw a sketch-map to show how the main cables bring current from the power station to your home.
135. With the aid of a diagram write a *short* description of a modern coal mine.
136. From the photograph on page 212, try to draw a map or plan of the surface buildings of a modern colliery. Label each building, *e.g.* runways, washing-plant, pit-head, winding engine, etc.
137. Using the picture on page 218, describe a lignite mine, and explain how the coal is used to produce power.
138. Make a summary, by continents, of the chief coalfields of the world.
139. Why is oil replacing coal in ships? Explain how mineral oil is produced.
140. Describe what attempts are being made (*a*) to use coal in big power stations more economically, (*b*) to produce oil and petrol from other substances.

CHAPTER XV

141. Name a number of tropical crops that are used for the manufacture of useful substances needed in everyday life. Say what each is used for.
142. What is meant by "vegetable oils"? Give examples, and say what each is used for.
143. Write a short account of the manufacture of soap, mentioning the raw materials used and from what parts of the world they are obtained.
144. How is salt obtained? Mention some of the substances which are made from it.
145. What climatic conditions are needed for the production of rubber? Where are the chief producing areas? Mention some of the uses of rubber in everyday life.
146. What is copra? How is it obtained and for what is it used?
147. Compare the diagrams on pages 142 and 224, and write down the important differences you notice in how the flax plant is used in different countries. Explain these differences if you can. (See also the map on page 140.)
148. What raw materials are used in the manufacture of paint? Write notes about each and the parts of the world from which each is obtained.
149. For what purpose is each of the following used? From what part of the world is it obtained: olive oil, ground nuts, castor oil, soda, bromine.
150. From what raw materials are the following manufactured? From what parts of the world are they obtained: cattle cake, ammonium sulphate, vulcanite, cooking fat, artificial silk.

CHAPTER XVI

151. Contrast ancient and modern forms of transport.
152. Why is cheap and rapid transport essential in modern life?
153. Write a short essay on "Transport in other lands?"
154. What are the main differences between (*a*) Roman roads, (*b*) coaching roads, (*c*) motor roads, (*d*) arterial roads?

155. Choose any trans-continental railway route and draw a map of it, inserting the principal cities along the route. Add a description of the kind of country passed through and mention any special geographical reasons why the railway follows its particular course (*e.g.* mountain passes, the crossing of rivers, etc.).
156. Give examples of how air transport has helped in the development of new territories.
157. What kinds of traffic are best handled (*a*) by air, (*b*) by rail, (*c*) by road, (*d*) by canal? Give reasons.
158. Choose any important long-distance ocean route and mention the chief ports of call, with the type of cargo likely to be unloaded or received at each port. Illustrate by a sketch-map. (Suggested routes are Liverpool to Buenos Aires, Southampton to Bombay, San Francisco to Hong-kong, London to New Zealand, Vancouver to Sydney.)
159. Give some account of the equipment and work of a modern port. Why does trade tend to be concentrated through a few very large ports?
160. Of what advantage are ship-canals? Give examples.

CHAPTER XVII

161. Cities tend to develop at the nearest point to the sea at which rivers can be bridged. Give three examples of such cities, illustrating your answer by neat sketch-maps.
162. Why do most people prefer to live in cities rather than in the country districts? What difficulties does this cause, and how do you think these difficulties can be overcome?
163. What problems have to be considered in planning a modern city? Make a plan of what you think would be a good lay-out for a modern city.
164. How is native life changing in Northern Rhodesia, and why?
165. What advantages and disadvantages are there in living in (*a*) a cottage in the country, (*b*) a modern "council" house, (*c*) an apartment, tenement, or flat in a city? Which would you prefer, and why?
166. How do modern factories differ from those built a hundred years ago?

167. Make a plan showing *your* idea of what a good school should be like. You should include everything that you would like it to have, including, of course, playing fields.
168. Mention some of the ways in which the life of the worker in a factory or an office may be improved. (Ask your father, brother, or sister about this.)
169. How do you think people will travel in the future? Give your reasons.
170. Write a description of an imaginary visit to a city in 2000 A.D.

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Ordinary figures (*e.g.* 172) refer to pages
Italic figures (*e.g.* *168*) refer to illustrations on that page

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